1031

SCHOOL OF CIVIL ENGINEERING

INDIANA DEPARTMENT OF HIGHWAYS

JOINT HIGHWAY RESEARCH PROJECT

JHRP-84-17

ENGINEERING SOILS MAP OF WHITLEY COUNTY, INDIANA FINAL REPORT

Edward M. Gefell

PURDUE UNIVERSITY

FINAL REPORT

ENGINEERING SOILS MAP OF WHITLEY COUNTY, INDIANA

TO: H.L. Michael, Director
Joint Highway Research Project

August 23, 1984

Project: C-36-51B

FROM: Robert D. Miles, Research Engineer
Joint Highway Research Project

File: 1-5-2-75

The attached report, entitled "Engineering Soils Map of Whitley County, Indiana," completes a portion of the project concerned with the development of a county engineering soils map of the state of Indiana. This is the 75th report of the series. The report was prepared by Edward M. Gefell, Research Associate, Joint Highway Research Project.

Mr. Gefell developed the map and report using aerial photographs, literature, available soil borings and limited field studies. Generalized soil profiles of the major soils of each land form - parent material area are presented on the engineering soils map included.

The report is presented to the Board as evidence of completion of the Whitley County engineering soils mapping project.

Sincerely,

Robert D. Miles

Robert D. Miles, P.E.
Research Engineer

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Final Report

ENGINEERING SOILS MAP OF WHITLEY COUNTY, INDIANA

by

Edward M. Gefell
Research Associate

Joint Highway Research Projects
Project No: C-36-51B
File No: 1-5-2-75

Prepared as a part of an Investigation
Conducted by
Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with
Indiana Department of Highways

Purdue University
West Lafayette, Indiana
August 23, 1984

Acknowledgements

The author wishes to express his sincere gratitude to Professor Harold L. Michael, Director of the Joint Highway Research Project and to the other members of the board for their continued support of the engineering soil mapping project and for extending the period of time in which he was allowed to work on the mapping project. Special thanks goes to Professor Robert D. Miles for his professional advice, guidance, and editing as well as his friendly words of support and personal interest in the affairs of the author throughout the two and one half years of his employment with JHRP. The author would also like to acknowledge Rita Wolf, Marion Sipes, and Dawn Leverknight for the many laborious hours they spent (without complaint) in front of the word processor hammering out the soils reports, and to Debbie Gonzales and Eric Chen for their near-flawless drafting.

Thanks again, and good luck to everyone in the future.

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ENGINEERING SOILS MAP
OF
WHITLEY COUNTY, INDIANA

Introduction

The Engineering Soils Map of Whitley County, Indiana (see Figure 1) was developed primarily by interpretation of 1951 aerial photographs using accepted principles of observation (1)*. A photomosaic was assembled of the area and land form - parent material associations delineated by stereoscopic inspection. A 1951 photomosaic of Whitley County is shown in Figure 2. Review of available literature supplemented aerial photographic interpretation in locating the engineering soil boundaries. In the absence of an agricultural soil survey for Whitley County, liberal use was made of the Noble County Soil Survey (2) in determining parent material characteristics for areas north of the Eel River and likewise with the Allen (3a) and Huntington (3b) County Soil Surveys for areas south of the Eel River. All three adjacent county soil surveys (4) were referred to for the regional engineering soils found throughout Whitley County. The aerial photographs used in this project had an approximate scale of 1:20,000 and were purchased from the United States Department of Agriculture.

A two - day field trip was taken to the study area in order to correlate airphoto patterns observed in the laboratory with actual surface soil textures found in the field. Soil boundaries

* note: numbers in parenthesis footnote references.

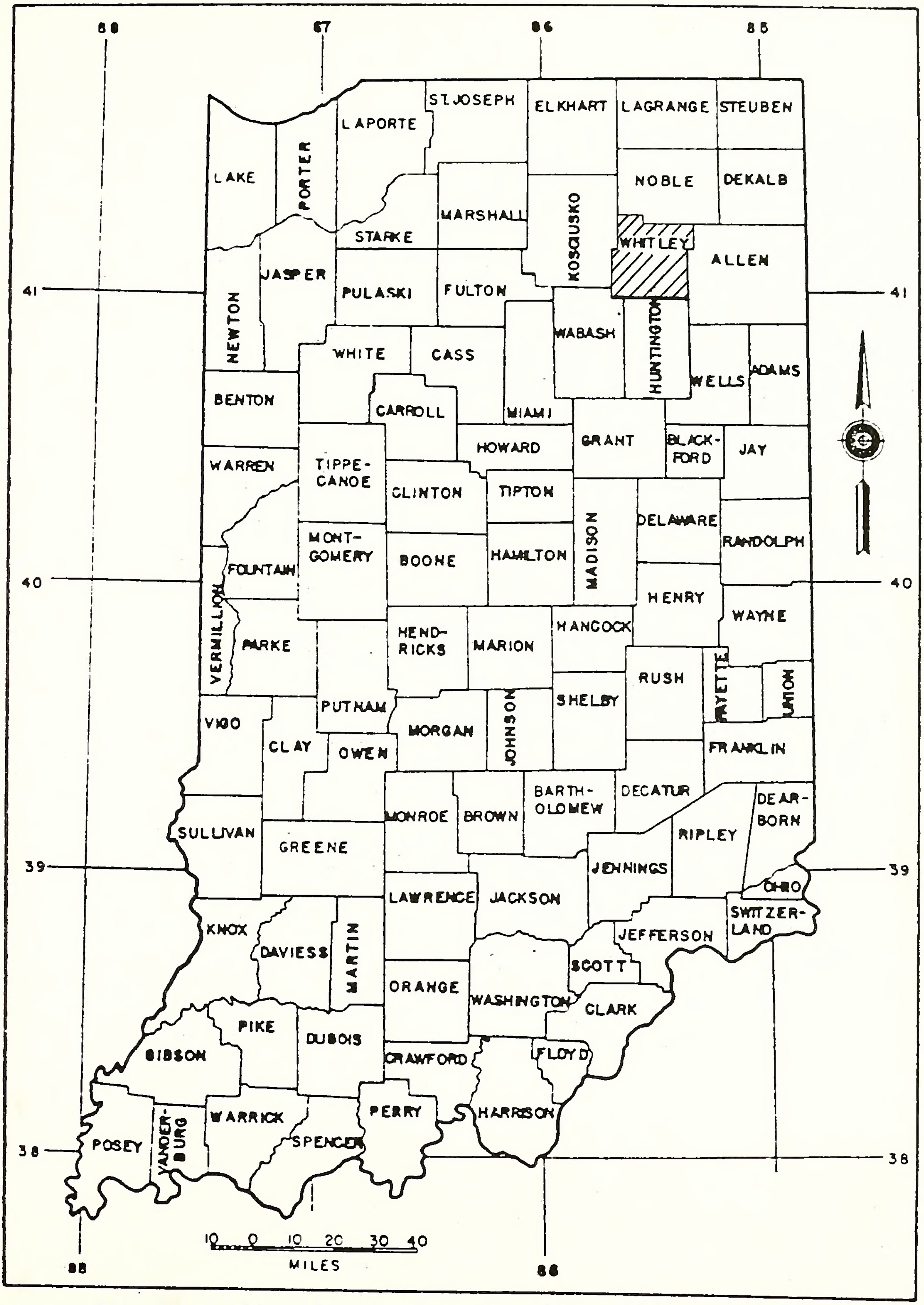


Figure 1. Map of Indiana showing Location of Whitley County.

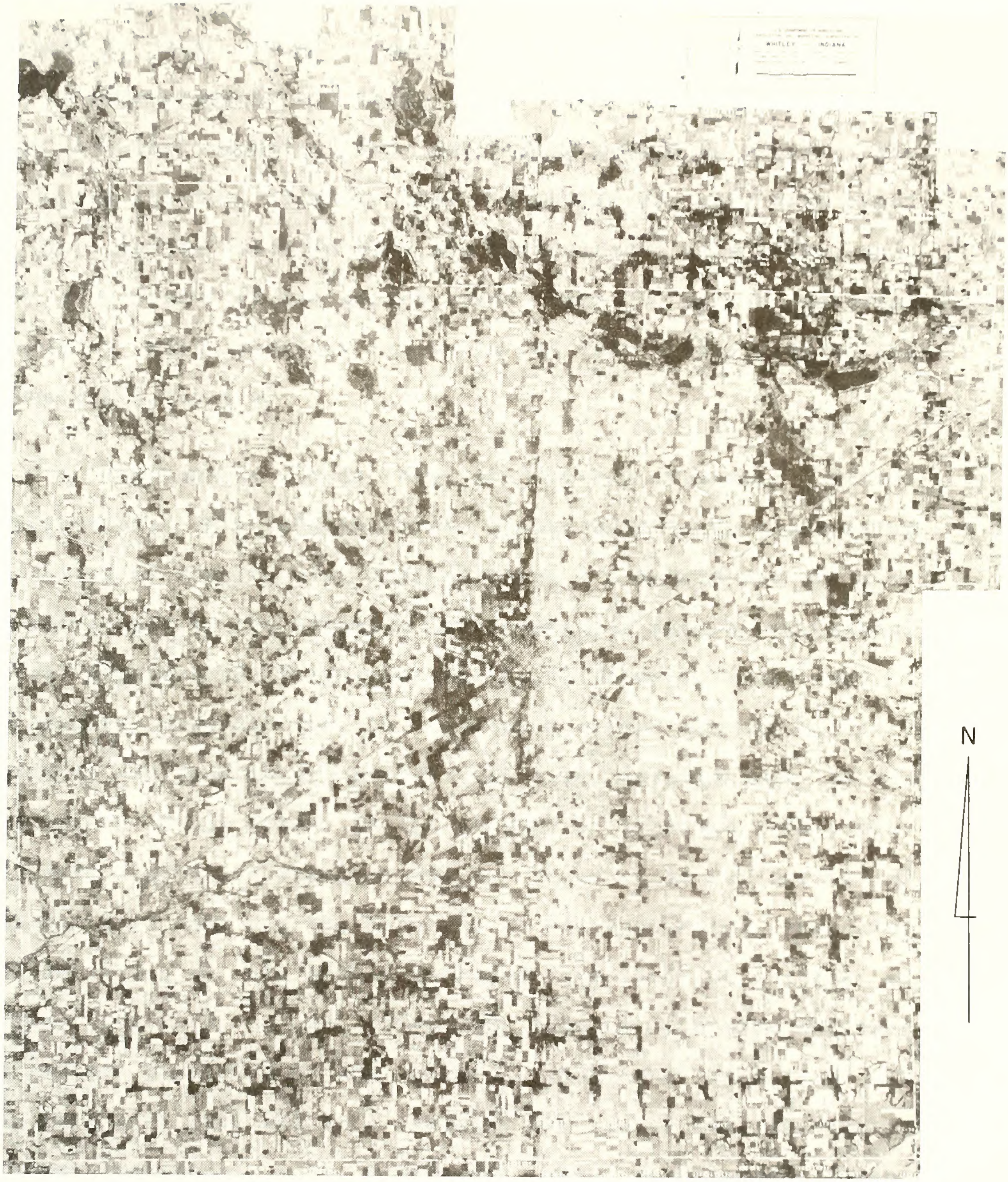


FIGURE 2. 1951 PHOTOMOSAIC OF WHITLEY COUNTY, INDIANA

were modified and ambiguous details resolved based on information obtained in the field. Numerous soil samples, extending to a depth of approximately 4.0 feet, were taken to determine the nature of the topsoils and underlying parent materials. The information obtained from the hand - sampling was used with roadway soil survey borehole data and agricultural soil survey data in the development of the general land form - parent material association soil profiles shown on the left - hand side of the engineering soils map.

The Engineering Soils Map of Whitley County, Indiana represents part of a comprehensive, county by county, engineering soil survey of the State of Indiana using a standard set of symbols developed by the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University. A primary objective of the mapping project was to develop a survey whereby all soil boundaries and land form - parent material associations correlated across county lines. In the process of airphoto interpretation, some subjective disagreement may occur as to the nature of a given soil unit and the location of its boundaries. Where the interpretations of this author differed from those of authors of adjacent counties, every effort was made to determine the land form pattern percieved by the other author and integrate the given soil unit into the soil boundary pattern of Whitley County. In some instances, soil boundaries were terminated rather abruptly, very near to the Whitley county line. Many of the anomalous areas were controversial due to a lack of adequate

relief (ie., less than five feet) on which to base a judgement for boundary placement by stereoscopic inspection. Other disputed areas resulted from differences in mapping detail between Whitley and adjacent counties.

The text of this report supplements the engineering soils map and includes a general description of the study area as well as more detailed information about the various land form - parent material associations found in Whitley County. The map itself shows the parent material areas, surface soil textures and generalized soil profiles. Available roadway soil survey data for the numbered boreholes shown on the map and the engineering properties, characteristics, and suitability of representative pedalogical soil series mentioned with regard to the various land form - parent material associations are given in appendices in the back of this report.

DESCRIPTION OF THE AREA

General

Whitley County is located in the northeastern part of the State of Indiana and has an approximate surface area of 336 square miles(5). Whitley County is bordered to the north by Noble County, to the east by Allen County, to the south by Huntington and Wabash Counties, and to the west by Wabash and Kosciusko Counties. Columbia City, located in the north - central part of the county about 105 miles northeast of Indianapolis, is

the seat of county government.

Whitley County had a population of 26,215 in 1980 of which 67.23 percent or 17,624 lived in rural areas(6). Table 1 shows the population changes by decades from 1900 to the present and gives projected population trends through the year 2000.

Table 1. Population Data for Whitley County(7).

Year	Population
1900	17,328
1910	16,892
1920	15,660
1930	15,931
1940	17,001
1950	18,828
1960	20,954
1970	23,395
1980	26,215
1990	28,100
2000	32,000

The data for future population growth was taken from a HERPICC study entitled 'Population Trends for Indiana Counties, Cities, and Towns' (6). Population data for towns and cities in Whitley County is given in Table 2. Most of the land in Whitley

Table 2. 1980 Population Data for Towns and Cities in Whitley County, Indiana(6).

Town/City	Population
Churubusco	1,638
Columbia	5,091
Larwill	286
South Whitley	1,575

County was used for agricultural purposes as of 1976(7), followed by forested land and developed urban or suburban land. 1976 land use data for Whitley County is given in Table 3.

Table 3. 1976 Land Use Data for Whitley County, Indiana(7).

Land Use	Acreage
urban	7,010
agricultural	186,250
forest	20,130
water	1,840
wetland	190
	215,420 total.

The data shown in Table 3 was compiled by the Regional Planning Commission's land use elements, LANDSAT data and other sources.

Major north - south roads in Whitley County include state roads 9 and 109 which serve Columbia City in the central part of the county and S.R. 5 which passes through the towns of South Whitley and Larwill on the west side of the county. Major east - west roads include U.S. 30 (a divided highway) and S.R. 205 which pass through Columbia City and S.R. 14 and S.R. 114 (serves as southern county line) in the southern half of the county. The road and street mileage data for Whitley County is summarized in Table 4. All the roads mentioned above are identified on the map which accompanies this report.

Table 4. Road and Street Mileage for Whitley County, Indiana(7).

Road Type	Mileage
state roads, toll roads and interstates	135.69
county roads	640.7
city streets	41.11
	817.50 total.

Climate

Whitley County is located in an area of temperate climate with warm, humid summers and cold, dry winters (8). Seasonal temperature variation is not extreme, however, temperature fluctuations on a daily basis are occasionally rather pronounced as frontal systems associated with high and low areas of pressure pass over the county. Temperature fluctuations are moderated to some extent by the Great Lakes. The following climatic information is based on data collected between 1938 and 1961 at Columbia City in Whitley County, Indiana. A summary of that data is shown in Table 5.

The warmest month of the year is July with a mean monthly temperature of 74.5° F and the coldest is January with a monthly mean of 26.7° F (8). The temperature exceeds 90° an average of 27 days per year and stays below freezing an average of 37 days per year. The mercury usually drops below 32° F on 131 days of the year and plummets below 0° F an average of four times per year.

Precipitation is fairly well distributed throughout the year, being somewhat greater in the summer than in the winter. The wettest month has statistically been July, in which an averages of about 4.19 inches of precipitation usually falls, while the driest month has been December which averages about 2.03 inches of precipitation (8). About 26 inches of snow falls per year while total precipitation averages just over 37 inches.

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
IN COOPERATION WITH COLUMBIA CITY CHAMBER OF COMMERCE
CLIMATOGRAPHY OF THE UNITED STATES NO. 20 — 12

LATITUDE 41° 09' N.
LONGITUDE 85° 29' W.
ELEV. (GROUND) 885 feet

Table 5. CLIMATOLOGICAL SUMMARY for Whitley County, Indiana

MEANS AND EXTREMES FOR PERIOD 1938-1961

STATION Columbia City, Indiana

	Temperature (°F)							**	Precipitation Totals (Inches)								Mean number of days					
	Means			Extremes								Snow, Sleet						Temperatures				
																		Max.		Min.		
Month	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year	Mean degree days	Mean	Greatest daily	Year	Mean	Maximum monthly	Year	Greatest daily	Year	Precip. .10 inch or more	90° and above	32° and below	32° and below	0° and below	Month
(a)	24	24	24	24		24			24	24		22	22		22		23	24	24	24	24	
Jan.	34.2	19.1	26.7	68	1950	-15	1940	1190	2.36	2.00	1959	7.1	16.3	1939	6.0	1939	6	0	13	28	2	Jan.
Feb.	37.8	21.7	29.8	69	1954	-16	1951	990	2.19	2.44	1939	6.3	15.5	1940	7.0	1961	5	0	8	25	1	Feb.
Mar.	47.8	28.5	38.2	84	1938	- 5	1943	830	2.98	2.00	1945	3.4	11.0	1947	5.0	1954	7	0	3	22	*	Mar.
Apr.	61.7	39.2	50.5	89	1942	15	1957	440	3.64	2.18	1960	1.2	10.0	1957	6.0	1957	8	0	*	8	0	Apr.
May	72.6	49.3	61.0	93	1942	27	1947	190	3.69	2.12	1945	T	T	1954+	T	1954+	8	1	0	1	0	May
June	82.3	59.6	71.0	101	1944	37	1956	30	4.04	3.32	1938	0	0		0		7	5	0	0	0	June
July	86.1	62.5	74.5	100	1954	46	1944+	0	4.19	2.92	1951	0	0		0		6	9	0	0	0	July
Aug.	85.3	61.4	73.4	102	1947	43	1946	0	3.45	2.52	1958	0	0		0		6	8	0	0	0	Aug.
Sept.	79.1	53.9	66.5	103	1953	30	1942	80	2.64	2.02	1950	0	0		0		5	4	0	*	0	Sept.
Oct.	67.6	43.5	55.6	91	1952+	23	1952	320	3.07	3.52	1954	T	T	1954+	T	1954+	5	*	0	4	0	Oct.
Nov.	49.1	32.1	40.6	80	1950	- 4	1950	730	2.84	1.75	1955	2.7	14.4	1950	6.0	1942	6	0	2	16	*	Nov.
Dec.	37.2	22.4	29.8	65	1951+	-15	1951	1090	2.03	1.78	1961	5.4	16.3	1944	8.0	1944	5	0	11	27	1	Dec.
Year	61.7	41.1	51.4	103	Sept. 1953	-16	Feb. 1951	5890	37.12	3.52	Oct. 1954	26.0	16.3	Jan. '39 Dec. '44	8.0	Dec. 1944	74	27	37	131	4	Year

(a) Average length of record, years.

T Trace, an amount too small to measure.

** Base 65°F and computed from monthly mean temperatures.

+ Also on earlier dates, months, or years.

* Less than one half.

CLIMATE OF COLUMBIA CITY, INDIANA

Columbia City is located in Whitley County in northeastern Indiana. It was the home of Thomas R. Marshall, who was Vice-President under Wilson, Governor of Indiana, and supposedly the first to say, "What this country needs is a good five-cent cigar." While no tobacco grows around Columbia City, the people have taken advantage of the climate in many ways. Corn and soybeans are leading crops on the level fertile soils. In the hillier areas to the northwest, dairying is a popular agricultural endeavor. Like other areas of the central United States, the differences between summer and winter at Columbia City are pronounced--not in precipitation but in temperature.

Weather changes of a few days cycle, which are closely associated with the passing of low and high air pressure centers through the area, are a characteristic of the climate. In general, the high's bring lower temperatures, lower humidity and greater sunshine. Often accompanying the low's are higher temperatures, winds, humidity, and rain or showers. These alternations are of dimished intensity in the summer, but thunderstorm activity increases beginning in the spring when the sun shines more directly and longer on the cool, moist soil.

Columbia City is fortunate in generally having an even distribution of precipitation throughout the year, a happy contrast to areas that have a "dry season". As indicated by the monthly rainfall of past years given in this report, the locality seldom has a really dry month. Precipitation is a little less in the winter months than in the spring and summer months. The agriculture of the area is geared to take advantage of the high probability of regular rains, resulting in excellent forage and grain crops.

Temperatures during many months of the year are nearly ideal for humans, neither too hot nor too cold. Daily minimum temperatures average in the 50's or low 60's from June through September. Daily maximum temperatures average in the 70's and middle 80's from May through September. Temperatures drop below zero about four times a year. Freezing temperatures have not occurred in June, July, or August.

Relative humidity is not measured at Columbia City but the climatology of the area indicates a variation from the 40's in percent during a typical summer afternoon to the 90's just before dawn. In the winter, the most probable range from the afternoon to the late night is from the 70's to the 90's. Relative humidity is lowered when cold fronts pass. South winds usually increase the humidity. Fog, reducing visibility to less than ¼ mile, is reported in the area about six days a year, mostly in the winter months.

Snowfall averages 26 inches a year, but amounts are low in some years and high in others. The first snow exceeding one inch comes half of the time by December 9. In ten percent of the years such a snow comes before November 8. The greatest snow on any day during the past 22 years was 8 inches which fell December 11, 1944.

Heating degree days in the above table provide a comparative number for calculating heating requirements between different places and different times. Fuel consumption for heating is proportional to degree day totals, so a month with twice the heating degree days of another month requires twice as much fuel for heating. Degree days for a single day are obtained by subtracting the day's mean temperature from 65°F.

Thunderstorms, including lightning and thunder, occur on about 42 days of the year, according to the climatology of the area. The average is one a month in February, increasing to eight a month in June and July, and then diminishing to one in December. Damages to property from high velocity straight winds generated by thunderstorms are most apt to occur in the spring months, but they seldom cause extensive loss of property. Only five tornadoes have been reported in the county; none caused fatalities.

Winds blow most frequently from the southwest, however in one or two of the winter months the average wind direction is west. Freezing rain or drizzle is expected about nine times a year according to a study of the period 1939 through 1948.

The growing season (defined here as the number of days between the last spring and first fall temperature of 32°) averages 170 days in length. The season is 180 days or more in 25% of the years, and less than 159 days in 25% of the years.

Fall is probably the best season of the year for outdoor activities. About 11 days of each late summer and fall month are nearly cloudless, 10 are partly cloudy, and about 10 are cloudy. The sun shines 58% of the possible time.

Lawrence A. Schaal
Weather Bureau State Climatologist
Purdue University, Agronomy Department
Lafayette, Indiana

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1938	[illegible]	34.6	43.3	51.9	61.4	68.6	73.8	75.1	64.9	56.1	41.4	28.4	52.4
1939	[illegible]	36.8	37.4	44.2	62.6	71.0	72.2	70.6	68.6	53.5	40.0	33.4	51.0
1940	16.8	29.0	32.8	46.4	57.8	71.4	75.2	73.4	64.1	56.2	37.4	33.7	49.4
1941	26.8	24.4	33.0	54.3	61.2	70.0	74.9	72.6	69.8	56.3	43.2	36.1	52.0
1942	27.6	25.7	40.3	55.7	63.6	73.0	75.2	72.2	64.8	55.0	42.0	23.5	51.8
1943	25.9	31.5	38.4	47.0	59.6	74.8	75.0	73.9	62.6	53.8	39.0	28.2	50.6
1944	32.0	31.8	33.8	47.6	66.0	74.4	76.0	75.9	67.8	53.9	42.6	24.5	52.2
1945	20.2	[illegible]	50.0	52.0	55.2	67.4	77.8	77.8	67.4	52.2	42.2	24.0	50.6
1946	28.2	30.2	50.3	51.7	58.9	69.7	75.1	70.3	68.0	59.9	45.0	34.0	53.4
1947	30.0	31.8	32.8	49.0	57.4	67.8	71.6	80.2	67.2	62.1	36.4	29.8	50.5
1948	19.6	27.8	38.0	54.3	59.8	70.1	75.1	73.5	68.7	51.2	45.3	31.6	51.2
1949	[illegible]	32.5	40.1	49.9	62.7	73.4	77.8	74.0	61.1	59.0	41.1	33.2	53.0
1950	31.9	27.5	34.0	44.0	62.6	70.6	71.9	70.3	64.3	58.9	35.3	21.7	49.6
1951	28.9	28.5	38.2	47.7	62.4	68.6	73.0	70.6	63.6	57.4	34.3	27.4	50.0
1952	29.6	32.5	37.2	51.7	59.1	75.4	77.1	77.3	66.1	49.8	42.7	33.6	52.3
1953	31.4	33.9	39.9	47.2	63.1	74.6	76.3	74.7	67.7	58.9	43.7	32.7	53.7
1954	29.9	37.4	36.8	54.9	57.1	74.0	75.1	71.6	69.1	55.2	-	-	-
1955	25.6	29.8	39.2	57.7	63.5	67.9	78.6	76.2	68.0	54.1	37.3	26.8	52.1
1956	25.9	30.4	37.6	48.2	61.4	72.2	73.1	72.7	64.8	59.2	41.1	34.7	51.8
1957	20.5	33.5	38.7	50.9	61.3	72.0	73.9	71.2	62.3	48.9	38.4	34.9	50.5
1958	27.2	22.9	36.9	52.2	61.0	64.9	71.9	71.3	64.8	54.2	43.6	22.3	49.4
1959	22.8	29.0	38.3	52.1	66.5	72.9	74.4	78.0	69.4	53.2	35.7	35.6	52.3
1960	29.4	28.1	27.4	54.5	58.5	67.9	72.8	73.9	69.2	54.8	43.5	24.9	50.4
1961	21.2	33.7	47.5	43.7	57.6	70.1	73.3	72.5	71.3	57.8	42.2	28.1	51.8

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1938	1.35	3.38	4.66	3.59	5.46	7.23	5.03	2.93	2.40	1.06	1.28	1.78	40.10
1939	4.32	4.36	2.55	4.92	0.92	6.80	4.20	2.73	0.50	1.78	1.1[illegible]	0.97	[illegible]
1940	1.68	1.90	2.41	4.58	5.33	3.21	2.18	1.30	1.04	[illegible]	[illegible]	[illegible]	[illegible]
1941	1.98	0.56	1.37	2.89	3.37	3.77	0.85	2.46	0.90	[illegible]	3.70	1.57	[illegible]
1942	1.95	3.30	4.15	2.30	2.70	5.08	6.69	3.67	3.86	3.15	[illegible]	[illegible]	[illegible]
1943	0.93	1.31	3.47	3.73	8.10	1.38	6.45	4.61	3.69	1.76	[illegible]	0.31	[illegible]
1944	0.37	1.91	3.82	6.73	4.18	2.21	1.73	0.96	2.09	2.13	3.05	1.66	[illegible]
1945	0.63	1.54	5.57	3.17	5.58	4.24	4.49	3.31	4.20	2.78	1.16	2.43	39.10
1946	1.46	2.15	2.22	0.82	4.44	2.29	4.32	1.91	1.90	3.39	3.70	2.28	30.38
1947	3.09	0.60	2.08	4.46	3.79	2.86	2.65	2.83	5.31	4.25	2.16	1.90	36.10
1948	1.99	2.82	3.86	1.41	3.38	3.67	3.40	2.49	2.01	1.68	4.18	1.37	[illegible]
1949	5.53	3.04	2.39	1,35	3.79	5.06	2.40	4.31	1.89	6.34	1.28	2.90	40.28
1950	6.79	4.22	2.66	4.82	1.43	6.79	5.87	3.56	3.29	0.71	5.38	2.75	47.77
1951	2.01	2.13	3.16	3.46	3.73	4.02	6.36	4.68	-	4.43	2.35	1.55	-
1952	3.97	1.72	3.98	3.75	6,55	4.22	4.58	3.11	3.11	1.13	3.27	1.62	41.01
1953	2.10	1.74	3.86	3.24	2.60	2.06	2.50	4.88	1.70	2.06	1.31	1.15	29.20
1954	2.87	2,48	2.70	3.77	2.30	2.88	4.76	5.65	1.39	7.27	1.92	1.85	39.84
1955	1.73	1.54	3.70	3.09	3.41	2.91	7.63	4.91	1.93	5.74	5.90	0.77	43.26
1956	1.28	1.59	3.11	4.07	2.73	1.46	2.74	3.09	0.85	0.34	2.54	2.25	26.25
1957	1.22	0.99	1.22	5.48	2.78	5.88	2.65	3.95	4.27	4.63	2.20	5.21	40.48
1958	1.34	1.19	0.54	1.42	0.54	5.90	8.94	5.91	3.47	0.54	4.10	0.36	34.25
1959	5.60	2.14	2.84	4.94	4.80	5.15	2.25	2.27	3.88	3.83	3.45	2.94	44.09
1960	2.30	2.92	0.79	3.62	4.06	4.85	2.45	4.44	2.36	1.13	2.06	1.10	32.10
1961	0.19	3.14	4.38	5.64	2.59	3.14	5.54	2.96	4.40	2.48	2.79	1.78	39.01

STATION HISTORY

Daily reading of thermometers and rain gages by Columbia City citizens through many years of the past century make this summary possible. At the present time Max Johnson of the Post and Mail Publishing Company takes the climatological observations from instruments located at 329 West Main Street. Other employees of the Company have taken the observations since November 22, 1937. Less standard observations were taken in earlier years, the first known period running from September, 1865 to February, 1871. The next periods were: January 1, 1893 to November 30, 1899 by N. I. Fithcart; and October 1, 1921 to August 31, 1937 by William A. Snyder. An automatic recording rain gage from which intensity of precipitation for periods of minutes to hours are calculated has been operated by Hugh H. Frank since May 21, 1940. This rain gage is located .7 mile south of central Columbia City.

PROBABILITY OF EXTREME RAINFALL BASED ON AUTOMATIC RAIN GAGE MEASUREMENTS

Frequency in 100 years	Inches of rain in minutes or hours: 10 min.	20 min.	40 min.	1 hour	2 hours	4 hours	8 hours	12 hours
2	1.3	1.8	2.3	2.5	3.0	3.6	4.3	4.7
4	1.2	1.6	2.1	2.3	2.8	3.3	3.9	4.2
8	1.0	1.5	1.8	2.1	2.4	2.9	3.6	3.7
20	.9	1.2	1.5	1.7	2.2	2.5	3.0	3.2
40	.8	1.1	1.3	1.5	1.8	2.2	2.5	2.8
100	.6	.8	1.0	1.1	1.3	1.6	1.9	2.2

PROBABILITY OF LOW TEMPERATURES IN SPRING AND FALL

Minimum Temp.	Percent of occurrence after the date in spring: 90%	75%	50%	25%	10%	Percent of occurrence before the date in fall: 10%	25%	50%	75%	90%
40	5/7	5/13	5/20	5/27	6/2	9/13	9/20	9/23	9/30	10/3
36	4/28	5/4	5/11	5/18	5/24	9/19	9/26	10/3	10/10	10/17
32	4/10	4/18	4/22	5/6	5/14	9/30	10/6	10/14	10/22	10/28
28	3/24	4/4	4/12	4/20	4/28	10/19	10/25	11/2	11/9	11/15
24	3/15	3/22	4/1	4/10	4/18	10/27	11/3	11/10	11/17	11/23
20	3/1	3/11	3/22	4/2	4/12	11/7	11/15	11/24	12/3	12/11
16	2/18	2/28	3/11	3/22	4/1	11/10	11/18	11/27	12/6	12/14

This table summarizes the dates in the past 24 years when low temperatures such as 32°F. last occurred in the spring and first occurred in the fall. The average date is given in the 50% column. In lower percentages the date is later in the spring and earlier in the fall as the frequency of these low temperatures diminish. Some smoothing of data resulted when the probable normal pattern was calculated from only 24 years of data.

Extreme rainfall probability data are given in Table 5.

Physiography

The physiography of Whitley County, Indiana is roughly divided into two areas by the Eel River and is shown in Figure 3. The area north of the Eel River is part of the Steuben Morainal Lake division of the Northern Lake and Moraine region (5). The area south of the Eel River is part of the Tipton Till Plain physiographic region of the state of Indiana. Whitley County lies in the Eastern Lake section of the Eastern Lowland Province of the United States.

Topography

The topography of Whitley County, like its physiography, is approximately divided into two characteristicly different areas by the Eel River. The kettle - kame and ridge moraine areas to the north of the river are typically rugged with local relief commonly in excess of 50 feet. Some kames and sandy till - knolls in the morainic area rise up to 80 feet above the local base level (5). The ground and ridge moraine which predominate south of the Eel River are characteristicly flat to gently undulating and undulating to gently rolling, respectively, and are broken occasionally by subdued sandy knolls, swales, and stream valleys. Local relief in areas of ground moraine generally does not exceed approximately 15 to 25 feet. Local relief of the sub-

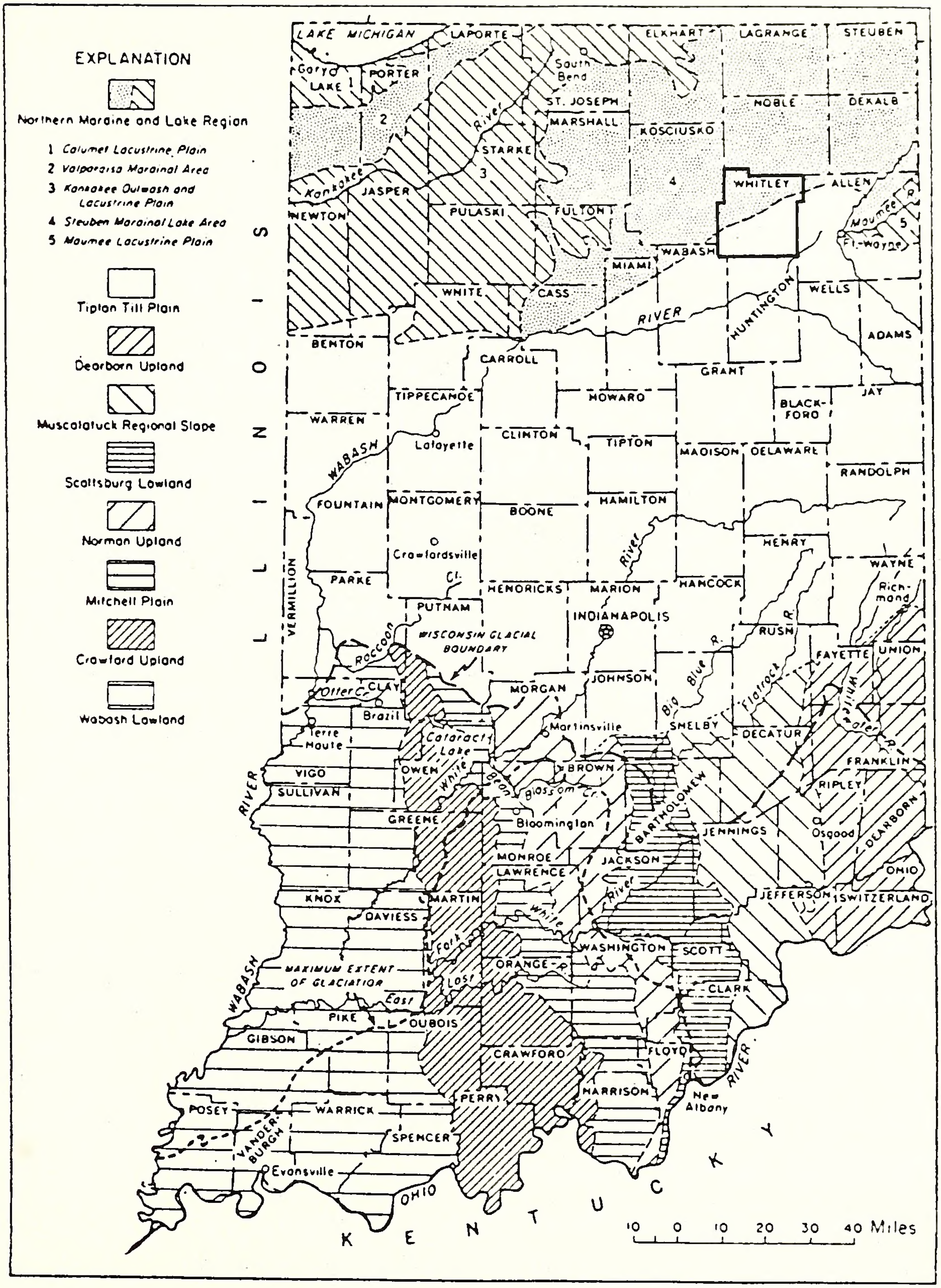


Figure 3. Map of Indiana showing Surficial Physiography and Location of Whitley County.

dued ridge moraine south of the Eel River ranges from about 20 to 35 feet. The maximum altitude in Whitley County is about 960 feet above sea level and is found in several places within the ridge and kettle - kame moraine in the northwest part of the county (9). A minimum altitude of 775 feet above sea level is located where the Eel River exits the county at the Kosciusko County line. The average land surface elevation generally decreases from the northwest to the southeast. This trend is broken in the southern half of the county by the valley of the Eel River. A topographic map of Whitley County is shown in Figure 4.

Drainage

Whitley County lies entirely within the Wabash drainage basin of the State of Indiana(5). The northwest corner is in the Tippecanoe subdivision and the southeastern corner is in the Little Wabash subdivision. The central part of the county near the Eel River is in the Eel subdivision and a small area in the south - central part is drained by minor tributaries of the Wabash River proper. A drainage map for Whitley County is shown in Figure 5.

The regional flow of water is to the southwest in a generally dendritic drainage system, however, drainage within the county is commonly haphazard, taking on a deranged pattern in many places, particularly in areas of kettle - kame moraine. The higher drainage density in the northwest part of the county

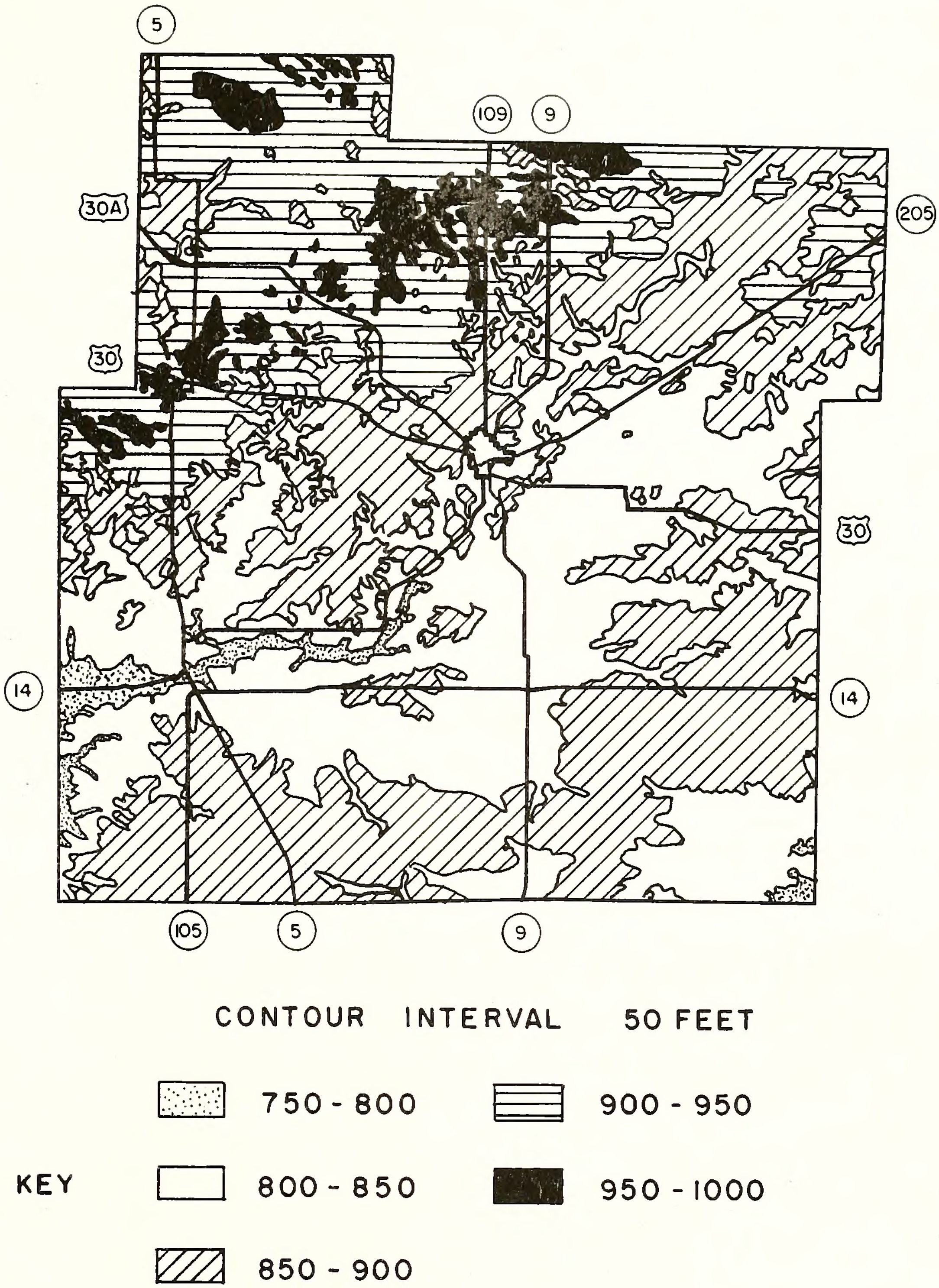
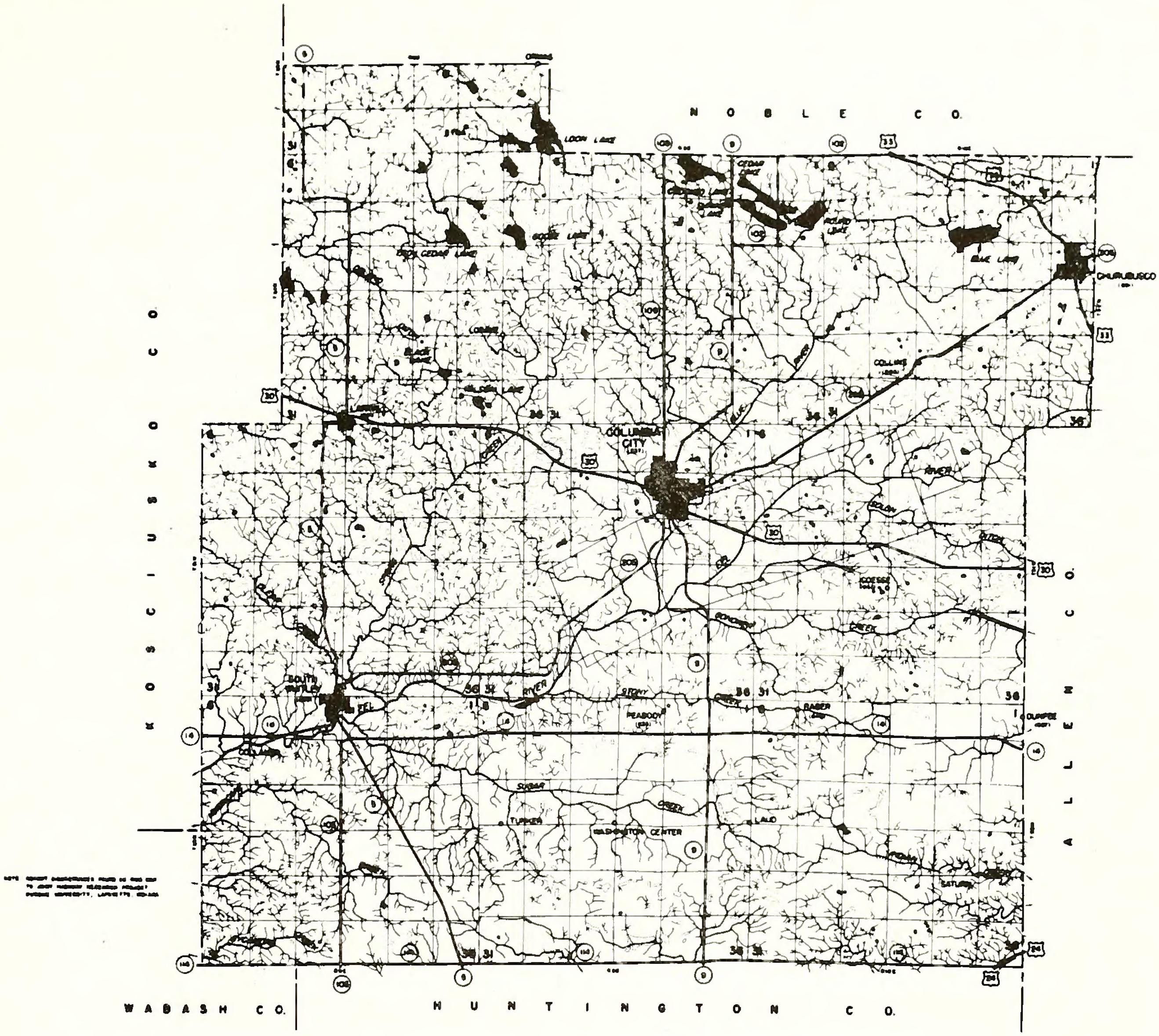


FIG. 4 : TOPOGRAPHIC MAP OF WHITLEY CO.



DRAINAGE MAP

FIGURE 5. WHITLEY COUNTY (5)

INDIANA

(north of the Eel River) is indicative of the rugged topography associated with the ridge moraine and kettle - kame moraine. Drainage patterns are more regular south of the Eel River in areas of less rugged ridge moraine and ground moraine.

Numerous natural lakes are found in the ridge and kettle - kame moraine in the northern part of the county. The lakes, which range up to more than a mile in length, are irregular in shape and are found in kettle holes or ice block depressions. In many places, ditches help facilitate drainage between the lakes and ponds, and streams flowing into basins with no outlets in swallow - hole fashion are not uncommon, indicative of the relatively coarse textured parent material of the kettle - kame and ridge moraine north of the Eel River. The largest lakes in Whitley County include Troy Cedar Lake, Goose Lake, Loon Lake, Crooked Lake, Cedar Lake, Shriner Lake, Round Lake, and Blue Lake (see Figure 5 for locations).

The Eel River is dredged along much of its course to direct its flow by providing a definite path through which the water can easily move. In some places, the river looks much like a canal with long, straight stretches between abrupt, angular turns within its broad flood plain and terrace deposits. Spring Creek and the Blue River, both major tributaries of the Eel River as well as many smaller tributaries are also dredged to restrict and direct their flows.

Bedrock Geology

The bedrock underlying the overburden of Whitley County is of Silurian and Devonian age and is a part of the Dekalb lowland and Bluffton plain bedrock physiographic units of the State of Indiana(see Figure 6) (10). Devonian age rocks predominate over the bedrock surface and include shale, limestone and dolomite (11). Dolomite of Silurian age is exposed in an old, preglacial bedrock river valley in the southwest part of the county. The dip of the beds, approximately 20 feet / mile to the north - northeast and any structural features such as shear zones and joints are associated with the Cincinnati arch which is shown in Figure 7. Surficial bedrock geology is shown in Figure 8.

Two preglacial bedrock river valleys, part of the Metea Valley subdivision of the Teays River System, diagonally transect Whitley County, exiting in a southwesterly direction (12). These bedrock river valleys are seen clearly on a regional scale in Figure 9 and on a local scale in the bedrock topographic map shown in Figure 10. There are no known outcrops in Whitley County.

Glacial Geology

The Pleistocene deposits of Whitley County, Indiana are the result of at least three different glacial episodes, the most recent of which was the Wisconsinan. The deposits of the Illinoian and Kansan as well as any earlier glaciations are overlain

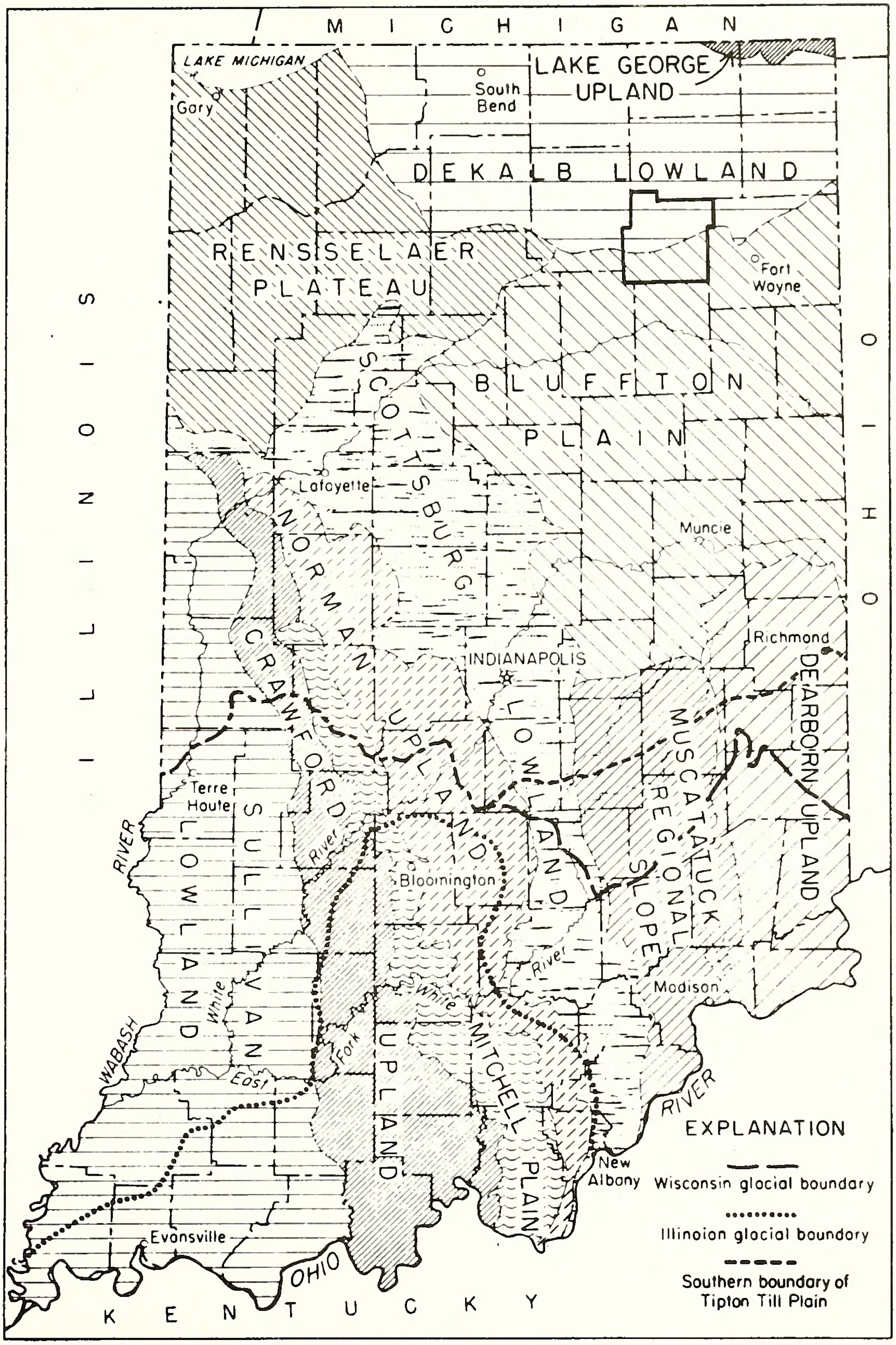


Figure 6. Map of Indiana showing bedrock physiographic units and location of Whitley County. Slightly modified from Indiana Geol. Survey Rept. Prog. 7, fig. 3 (10).

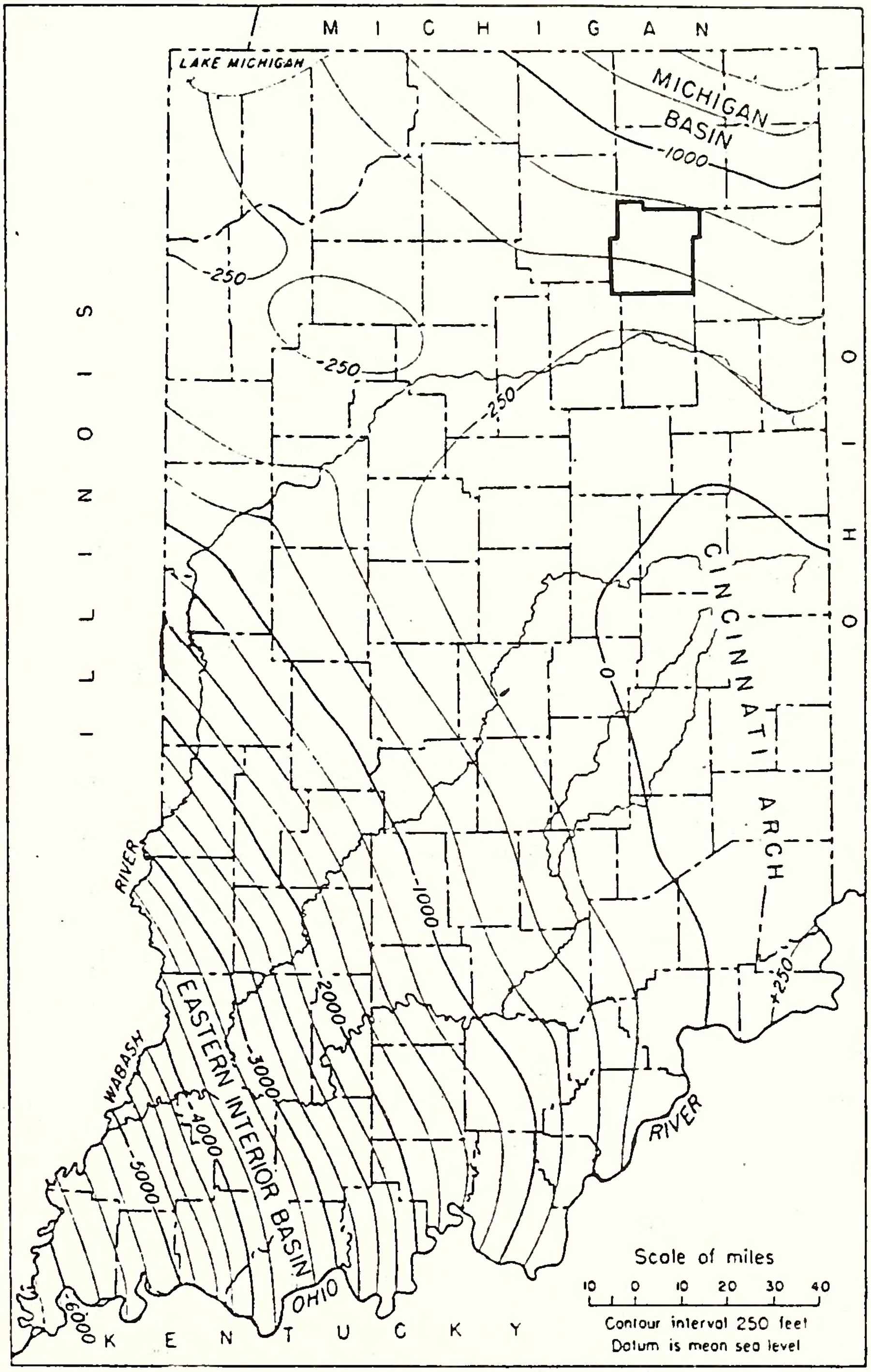


Figure 7. Map of Indiana showing Elevation of Top of Trenton Formation and Regional Bedrock Structure Related to Cincinnati Arch.

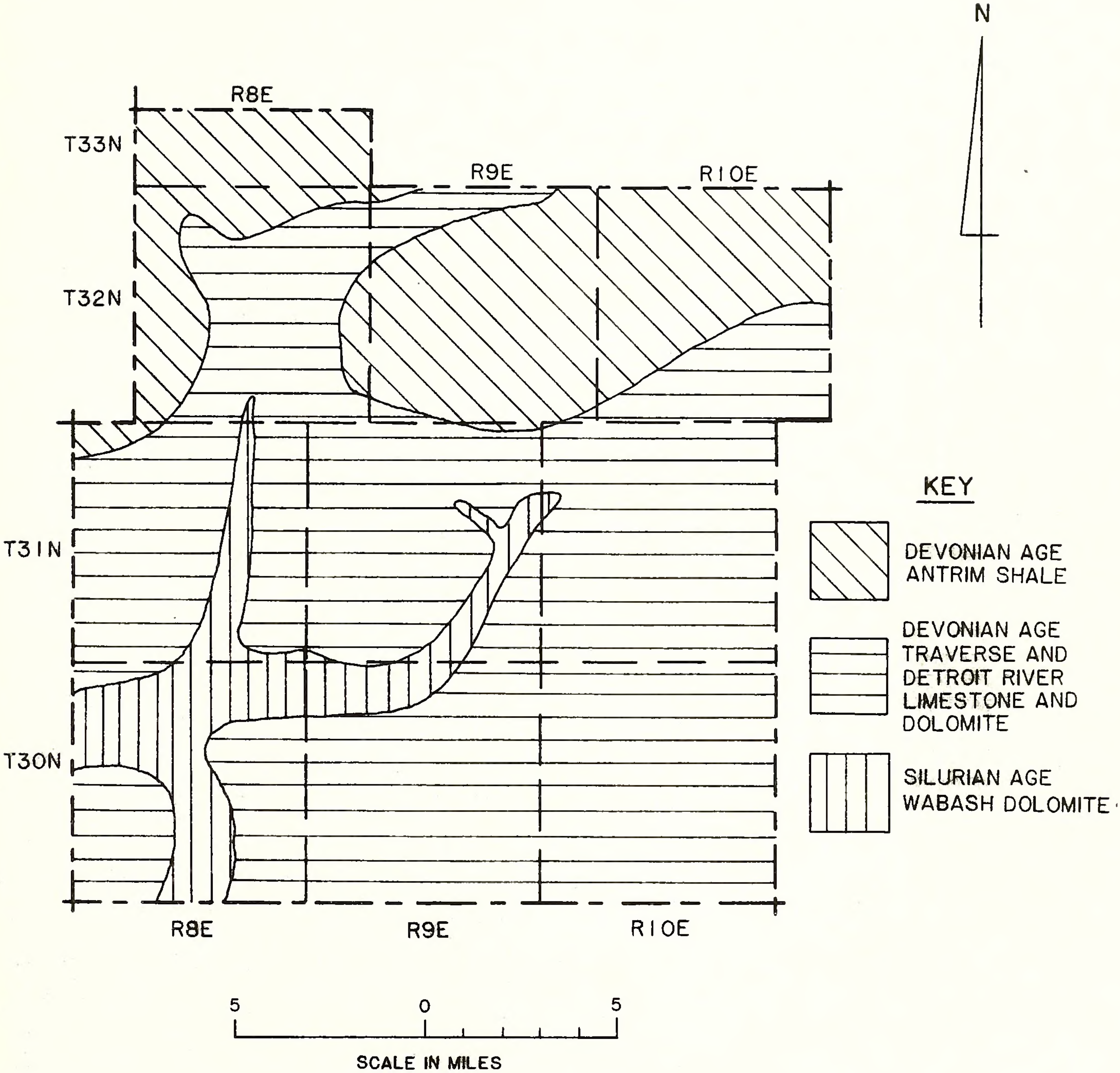


FIGURE 8. BEDROCK GEOLOGY OF WHITLEY COUNTY, INDIANA (11).

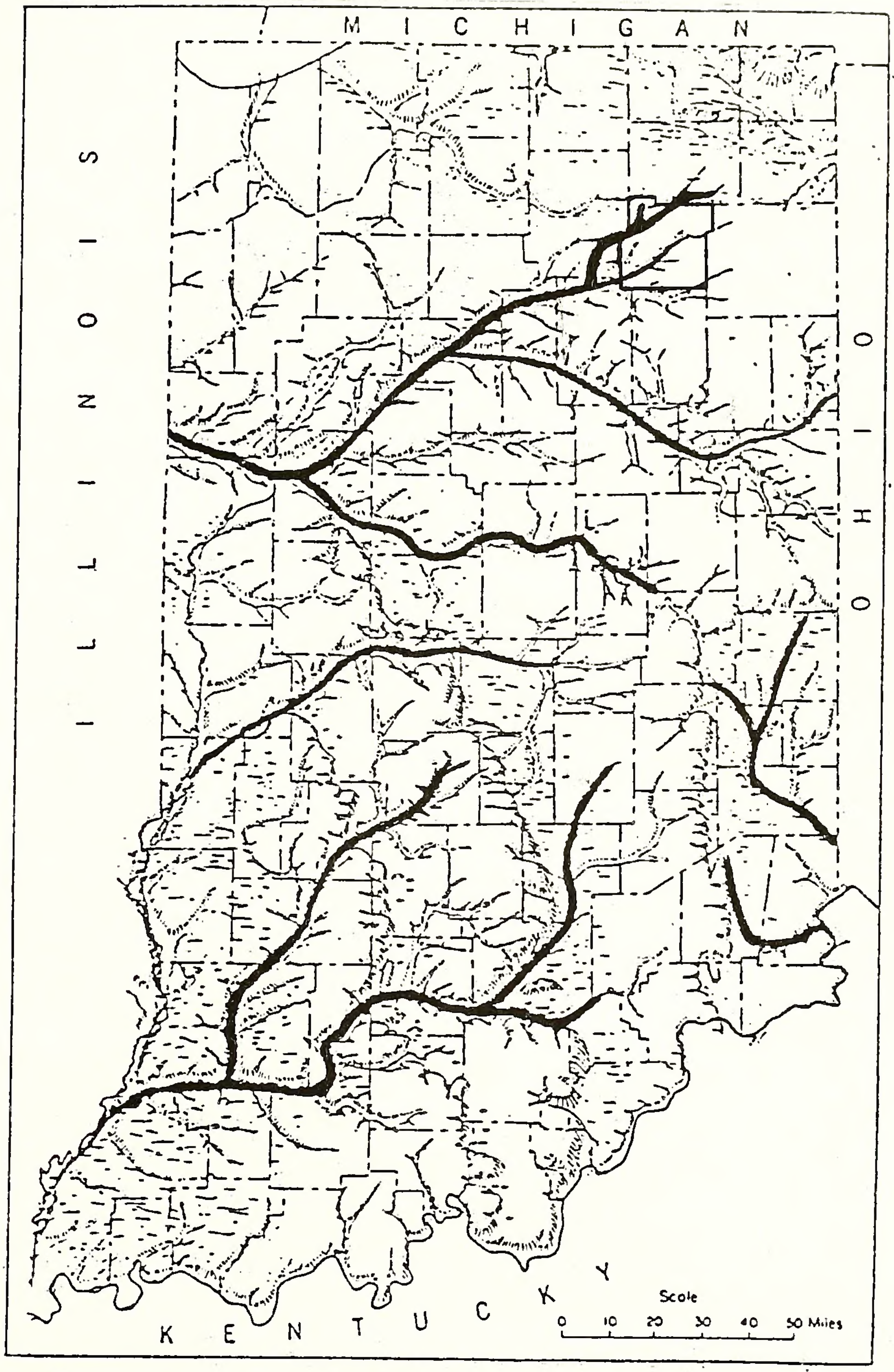


Figure 9. Map of Indiana showing Primary Pre-Glacial Bedrock River Valleys and Their Tributaries.

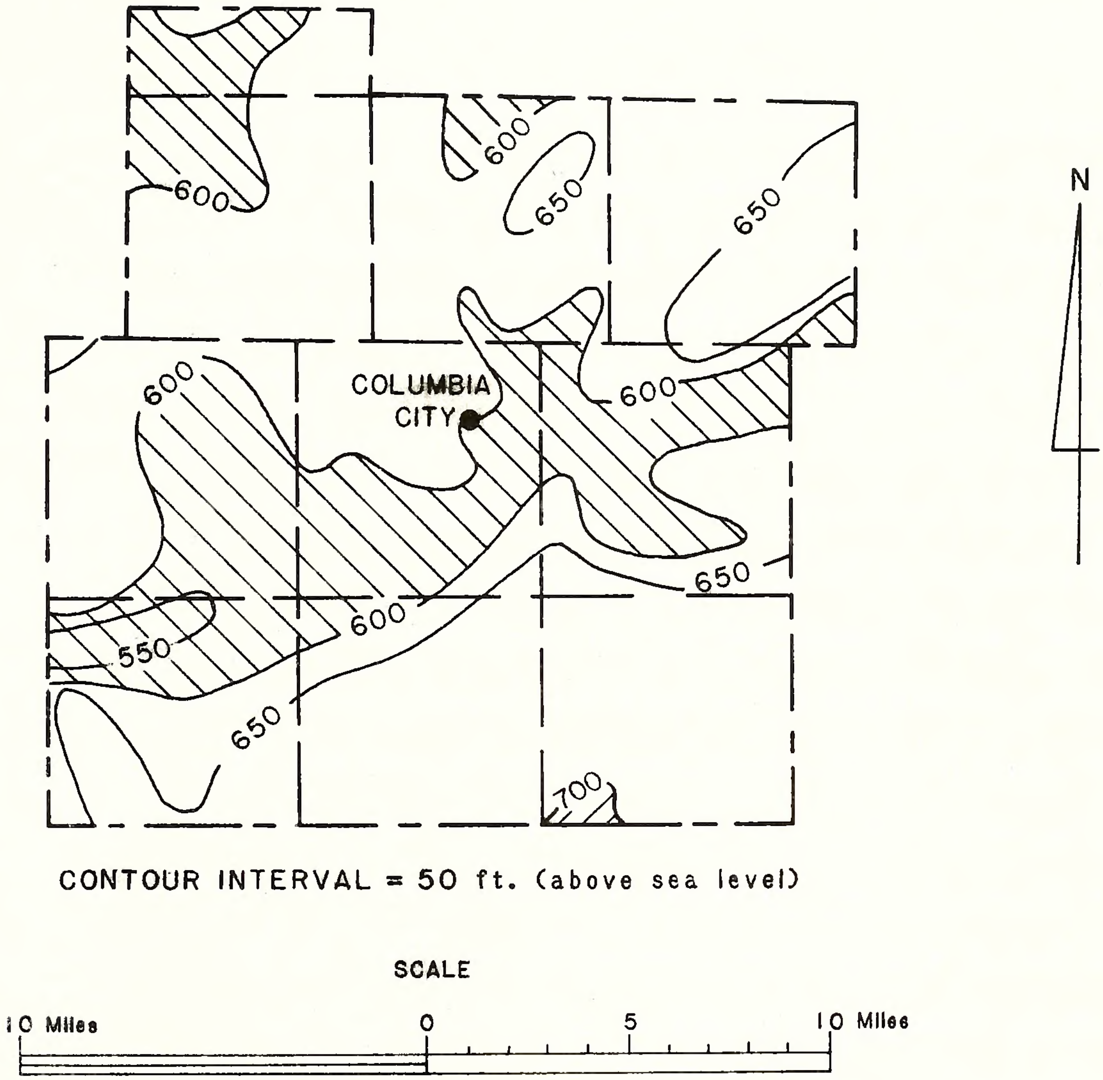


FIGURE 10. BEDROCK TOPOGRAPHY OF WHITLEY COUNTY, INDIANA (20).

by deposits of Wisconsinan age, which compose most of the surficial geology seen in the county. The only deposits not of Wisconsinan age in the county are composed of alluvium or cumulous (organic) drift of recent age.

The surficial glacial deposits of Whitley County are divided into those found north of the Eel River and those found south of the river. Deposits of kettle - kame and ridge moraine, characterized by medium - coarse textured(gravelly sand, silt, and clay) parent materials and rugged topography are found north of the Eel River. True kames and kettle lakes are not uncommon and sandy knolls and deposits of peat and muck are numerous. Medium - textured(sand, silt, and clay) ground and ridge moraine are the predominant glacial land forms south of the Eel River. The generally contrasting descriptions of the glacial physiography north and south of the Eel River is in agreement with that given by Shiltz (13). The subdued ridge moraine and the generally featureless stretches of ground moraine south of the river are part of the Tipton Till Plain physiographic unit of the State of Indiana (5). The rugged morainic area to the north is part of the Northern Lake and Moraine region.

The Packerton, Mississinewa, and Salamonie moraines stretch through Whitley County from the northeast to the southwest as mapped by Malott(14). The Salamonie and Mississinewa moraines were formed by the Erie Lobe of the Wisconsinan ice sheet while the Packerton moraine was apparently influenced to some extent by the Saginaw limb of the Huron Lobe and is referred to as

'interlobate moraine' by Chamberlain and others (15). The distinct boundaries of these moraines as mapped by Malott were not found by the author, however, the engineering soils map and that of Malott are in general agreement in that most of the rugged morainic areas are located north of the Eel River.

Drift thickness in Whitley County varies from over 350 feet in T32N, R8E to less than 100 feet in T30N, R10E, generally decreasing from northwest to southeast (see Figure 11) (16). Drift thickness is conspicuously not greatest over the primary preglacial bedrock valley found in the county. This phenomenon may be in part due to the relationship between the approximate inferred direction of movement of the Erie Lobe ice sheet with respect to the orientation of the bedrock valley and the increased deposition which apparently occurred in the Erie - Saginaw interlobate region. The Erie lobe ice apparently moved roughly parallel to the axis of the bedrock valley, tending to scour rather than fill it. If the ice motion had been perpendicular to the valley, then a 'bulldozer - like' effect probably would have occurred and the valley would have been completely filled. It is clear that regardless of the reason, the bedrock valley was either not entirely filled with glacial drift or the Eel River which presently flows approximately over the location of the old bedrock valley has subsequent eroded much of the drift that was deposited in the valley.

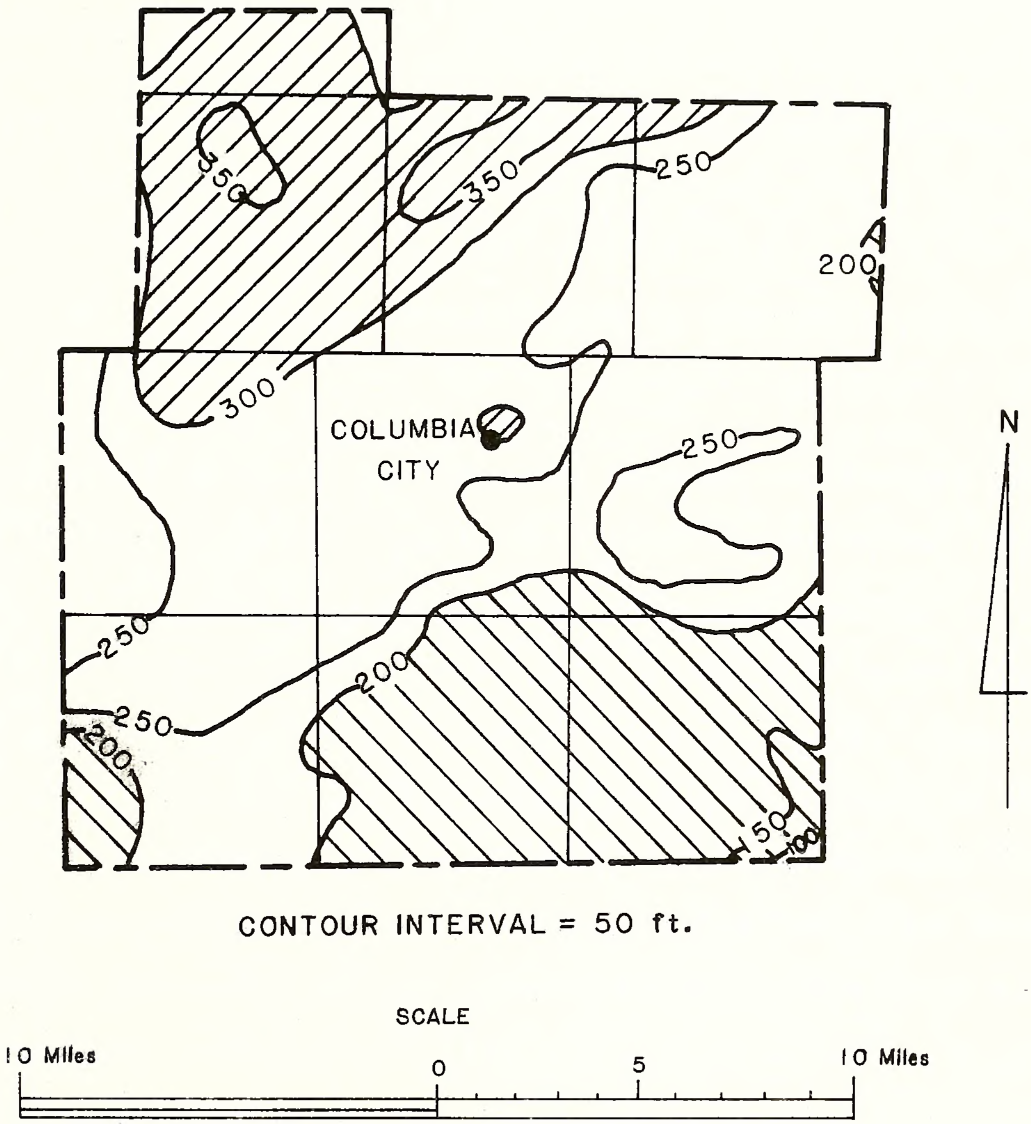


Figure 11. Drift Thickness Map of Whitley County (16).

ENGINEERING SOIL AREAS

The engineering soils of Whitley County, Indiana are divided into three groups as follows:

1) predominate engineering soils found north of the Eel River;

2) predominant engineering soils found south of the Eel River, and

3) regional engineering soils.

The Eel River roughly forms the boundary between the Steuben Lake and Moraine physiographic region of Indiana to the north of it and the Tipton Till Plain to the south. The engineering soils north of the river developed on rugged, relatively coarse textured glacial till and glacio - fluvial sediment of the Saginaw and Erie ice lobes and their interlobate moraine. South of the Eel River the engineering soils developed on medium textured till with properties and characteristics which varied less than those of the glacial till north of the river. Regional engineering soil areas are those found throughout Whitley County which do not exhibit any significant variation north and south of the river. The soils within the three primary categories were further subdivided according to land form and origin of parent material.

As stated previously, the Noble County Soil Survey(2) was used for developing the descriptions of the engineering soil types found north of the Eel river and the Huntington(3b) and

Allen County(3a) Soil Surveys were referred to for the soils south of the river. All three soil surveys (4) were referred to for the regional engineering soils.

The soil series mentioned in this report with respect to the land form - parent material associations found in Whitley County are those which developed in similar positions and parent materials in Noble, Allen, and Huntington Counties, Indiana. Engineering characteristics of representative pedalogical soil series are given in Appendix A in the back of this report and general soil profiles, developed from agricultural soil survey data and field sampling are shown on the left - hand side of the engineering soils map for the various engineering soil types described. Engineering data for the boreholes numbered on the map are given in Appendix B.

PREDOMINANT ENGINEERING SOIL AREAS NORTH OF THE EEL RIVER

Glacial (ice - contact) Deposits

Glacial or ice - contact deposits in Whitley County north of the Eel River include kettle - kame and ridge moraine with minor inclusions of ground moraine. An ice - contact deposit is any land form - parent material association formed and deposited directly by glacial ice. Both kettle - kame and ridge moraine are relatively coarse textured (A-2 to A-7), unstratified, heterogeneous deposits of glacial till which have both surface and subsurface, non-ice - contact parent materials within them (ie., cumulose drift, glacio - fluvial drift, etc.). Ground moraine is composed of a medium textured (A-4 to A-7) till which also commonly contains other parent materials and is described with the predominant engineering soils found south of the Eel River.

Kettle - Kame Moraine

The engineering soil areas designated as kettle - kame moraine on the engineering soils map are found nearly exclusively north of the Eel River. The term 'kettle - kame moraine' is herein used to describe glacial drift of very rugged terrain with knolls that rise up to 80 feet above the surrounding local base level (5). Few of these knolls proved to be true kames of glacio - fluvial origin during field investigations, however, some kames were located and the name kettle - kame moraine was retained in

order to differentiate the more rugged areas of moraine from ridge moraine of moderate relief (ie., generally 40 to 60 feet locally).

Areas of kettle - kame moraine are characterized by a haphazard, deranged pattern of drainage, typical of kettle - kame topography. Many streams enter and exit basins in which fluvial and cumulose drift accumulate. Cobble - sized rock fragments on the ground surface and kettle basins filled with organic material, some with small, enclosed intermittent ponds are more common in the areas of kettle - kame moraine than in the ridge moraine.

Knolls in the kettle - kame moraine are typically strewn with cobbles and boulders. Natural sideslopes of the more prominant knolls are relatively steep (ie., 70 percent or greater) (17) and exhibit erosional rills where vegetative cover is lacking. Slopes of road cuts through knolls , ranging up to one on one or steeper are stable, however, severe erosion is common due to the inability of vegetation to take hold.

The Rawson, Riddles, and Metea soil series are found on knolls in adjacent Noble County(2). The surface soil is generally a sandy loam(A-2 to A-4) which extends to a depth of approximately 13 inches. The surface soil is underlain by loam, clay loam or sandy - clay loam(A-6 to A-7) to a depth ranging from 41 to 52 inches beneath which is found a loam or clay loam soil(A-6 to A-7). The Metea soil series is found developed in thin, wind -

blown sands on some of the knolls in the northwest part of the county. The surface soil of the Metea series is characteristically a fine sand or sandy loam(A-2-4) which extends to a depth of about 37 inches. Clay loam(A-6 to A-7) reaches to a depth of 48 inches and is underlain by loam (A-6).

Deposits of peat and muck and highly organic topsoil occupy the low topographic positions in the kettle - kame moraine. Some of these depressions are true kettles while others are common swales of inconsequential origin. The organic matter in the deeper basins is commonly found interbedded with sand, silt, and/or clay which washes off the surrounding sideslopes or is deposited by through - flowing streams. Organic lacustrine deposits occupy some of the larger, flat low - lying areas in the kettle - kame moraine.

The Adrian, Edwards, Houghton, and Palms or similar soil series developed in the kettle basins of Whitley County(2). Peat or muck(A-8) was generally found to a depth of about 32 to 35 inches, however, it may reach to a depth of more than six feet in the case of the Houghton soil series. Beneath the peat and muck is a sandy loam(A-1 to A-3), marl, or a silty clay soil(A-4 to A-6). The content of organic matter ranges from 55 to 75 percent in the peat and muck (17).

Ridge Moraine

Ridge moraine in Whitley County north of the Eel River is relatively prominent and well developed compared to that found

south of the river. Surface accumulations of cobbles and boulders, deposits of peat and muck and highly organic topsoil, kames and organic lacustrine deposits are found in the ridge moraine north of the river, however, not to the same extent as in the kettle - kame moraine. Ridge moraine and kettle - kame moraine comprise most of the area north of the Eel River.

The soils on the knolls in the ridge moraine are similar to those which developed on knolls in the kettle - kame moraine(2). However, the parent materials and soils of the ridge moraine are texturally less coarse than those of the kettle - kame moraine(ie., fewer cobbles, boulders and less gravel).

The Rawson, Metea, and Riddles or similar soil series with small inclusions of the Miami series are found on knolls of the ridge moraine north of the Eel River. These soils are characterized by a sandy loam(A-2 to A-4) surface soil which extends to a depth of from 9 to 29 inches(2). Sandy clay - loam or silty clay - loam(A-4 to A-6) underlays the surface soil to a depth of 36 to 42 inches. Clay loam(A-4 to A-6) is found beneath a depth of about 42 inches. The Riddles soil series is characterized by a loamy soil(A-6) from 14 to 28 inches of depth. Clay loam(A-6 to A-7) extends from 28 inches to a depth of 64 inches and is underlain by loam(A-2 to A-6).

Swales in the ridge moraine north of the Eel River lie as much as 50 to 60 feet beneath the tops of surrounding knolls. Small kettles containing peat and muck, perhaps with intermixed

alluvial material, deposits of highly organic topsoil, organic lacustrine deposits, and deposits of peat and muck of non - kettle origin occupy the topographic low positions in the ridge moraine. Kettle deposits are discussed under the heading 'Kettle - Kame Moraine' and organic lacustrine deposits are hereafter described with the other engineering soils found north of the Eel River. Highly organic topsoil and deposits of peat and muck of non - kettle origin are considered regional soil types and are covered under that heading in this report. The most common form of swale deposit in the ridge moraine north of the river is unlike the special cases listed above and is described below.

The Brookston, Parr, and Blount or similar soil series developed in the most common swales in the ridge moraine north of the Eel River (2). These deposits are characterized by 12 inches of a loam or silt loam(A-4 to A-6) surface soil which is underlain to a depth of about 46 inches by clay loam, silty clay - loam, or silty clay(A-6 to A-7). Beneath 46 inches is found loam or sandy loam(A-4 to A-6) or clay-loam or silty clay-loam(A-6 to A-7). The Parr soil series is characterized by a loam or clay loam(A-4 to A-6) subsoil which extends from a depth of about 12 to about 31 inches. Loam(A-4) is found beneath 31 inches of depth.

Lacustral Deposits

Organic Lacustrine Plains

Organic lacustrine plains are found strictly in the kettle - kame and ridge moraine in the Steuben Lake and Moraine subdivision of the Northern Lake and Moraine physiographic region north of the Eel River in Whitley County. These deposits are inferred to represent the end results of the process of eutrophication which took place in what were once relatively shallow, irregularly shaped lakes of glacial origin. The lakes formed in ice - block depressions, kettles, or in low - lying areas left in the glacial drift as the ice receded. Cumulose (organic) drift and detritus from surrounding sideslopes comprise the bulk of the material which filled the former lakes. The process of eutrophication was hastened in some cases by sediment contributed by inflowing streams. These streams commonly meander over the nearly flat organic lacustrine deposits today, reworking the sediment and organic material and depositing new alluviam. In many places, dredged trenches guide the streams and help facilitate drainage. Three organic lacustrine deposits were found adjacent to the shores of existing lakes in sections 10-13, T32N, R8E and sections 9 and 10, T32N, R10E supporting the theory of the origin of these deposits.

Organic lacustrine deposits are characterized by stratified layers of sandy silt and clay sediment which are overlain by and intermixed with peat and muck. The Edwards, Palms, and Toledo or

similar soil series developed on the organic lacustrine deposits in Whitley County (2). The Palms and Edwards soil series are characterized by 35 inches of a peat and muck(A-8) surface soil which is composed of 55 to 75 percent organic matter(17). The surface soil is underlain by marl with shells or silty clay(A-4 to A-6). The Toledo soil series is characterized by nine inches of an organic silty clay - loam, silty clay, or clay loam(A-4 to A-6) surface soil which is underlain to a depth of 45 inches by clay or silty clay(A-7). Organic matter content of the Toledo soil series ranges from three to eight percent (17).

Beach Deposits

Narrow deposits of beach sediments, commonly associated with organic lacustrine deposits, are found in Whitley County around existing lakes of glacial origin in the ridge and kettle - kame moraine north of the Eel River. The beach deposits are of light photo - tone as opposed to the darker colored organic deposits and are located on the fringes of the lakes on the aerial photographs. One beach ridge located in section 9, T32N, R10E is surrounded by organic lacustrine material while another ridge separates two small lakes in sections 11 and 12, T32N, R8E. Some beach deposits, not associated with present - day lakes and although undetected, are inferred to exist on the fringes of, and in some cases may even be overlain by material of the organic lacustrine plains.

Field investigations indicate the beach deposits are composed of gravelly sand with some silt but little clay. The Noble County soil survey (2) describes 'lake borders' as deposits of stratified coarse to fine textured calcareous material which was exposed when the water table in that county was lowered by man - made drainage systems some 50 to 75 years ago. A similar man - made drainage network connects many of the basins and lakes north of the Eel River in Whitley County with the natural regional drainage system in that area. Some of the organic lacustrine, peat and muck, and beach deposits in Whitley County were probably exposed by the lowering of the ground water table, particularly those which do not border on existing lakes. Shiltz (12) concurs that man - made drainage facilities affected the ground water table as early as the late 1800's in Whitley County, exposing previously submerged lake deposits and draining low, swampy areas leaving peat and muck behind.

No specific soil series are given for the beach deposits in Noble County, however, the Belmore, Del Ray, and Martinsville series developed on beach ridges in Allen County and are used herein to provide a general description of the nature of the beach deposits in Whitley County. A loam or sandy loam(A-4 to A-6) surface soil extends to a depth of 11 inches and is underlain by a sandy loam or clay loam(A-4 to A-6) to a depth of about 28 inches(3a). Gravelly clay - loam or sandy loam(A-2 to A-6) is found between 28 and 40 inches of depth. Beneath about 40 inches is gravelly loam, sandy loam, or sand(A-1 to A-4). The surface

soil of the Del Ray series is underlain by a silty clay - loam or silty clay(A-6 to A-7) to a depth of 40 inches (3a). Sand or loamy sand(A-1 to A-3) is found beneath 40 inches.

Fluvial Deposits

Alluviam Over Organic Lacustrine Plains

Where through - flowing streams cross organic lacustrine plains alluvial sediment is deposited. Due to the ill - defined and frequently changing flow channel boundaries of these deposits, no map symbol was developed for them and they do not appear as delineated engineering soil areas on the map which accompanies this report. However, a general soil profile was developed from agricultural soil survey data and appears on the left - hand side of the map which accompanies this report. One should expect to encounter such deposits and should look for and locate them where stream(alluvial or flood plain) deposits are seen to enter and/or leave organic lacustrine deposits as shown on the map.

The Washtenaw, Fulton, Wallkill, and Wallkill Variant or similar soils developed in alluviam over organic lacustrine deposits in Whitley County(2). The Fulton series is characterized by a fine sandy loam, silty clay - loam or loam(A-4 to A-7) surface soil which extends to a depth of about nine inches and is underlain by clay or a silty clay - loam(A-7). The surface soil of the Washtenaw series is a loam or silt loam(A-4 to A-6) which is found to a depth about 35 inches. The subsoil is a clay loam or

silty clay - loam(A-6 to A-7) which is found to a depth of 56 inches and is underlain by a loamy soil(A-4 to A-6). The Fulton and Washtenaw series surface soils contain from three to eight percent organic matter. The Wallkill soil series is characterized by 18 inches of a silt loam(A-4 to A-6) surface soil which is underlain to a depth of about 42 inches by peat or muck(A-8). Beneath 42 inches is a silty clay soil(A-7). The Wallkill Variant soil series develops over thick deposits of organic matter and typically has a clay or silty clay(A-7) surface soil. Beneath the surface soil is peat and muck(A-8).

PREDOMINANT ENGINEERING SOIL AREAS SOUTH OF THE EEL RIVER

Glacial (ice - contact) Deposits

Glacial or ice - contact deposits south of the Eel River include ridge and ground moraine as well as small areas of kettle - kame moraine found adjacent to the river. The textural variation of the ridge and ground moraine parent materials south of the river is less than the mutual variation between them and the generally coarser till found north of the Eel River. Virtually the same soil series developed on high and low topographic positions of both ridge and ground moraine south of the Eel River due to the relatively little relief(i.e., generally 25 feet or less) and little textural variation, both characteristics of the Tipton Till Plain. This observation is in agreement with conclusions reached by Katsuyoshi Nishimura (18) during his M.S.E. Thesis work on the Erie Lobe recessional moraines in Indiana in the early 1950's. The soil series mentioned with regard to the engineering soils found south of the river developed on similar land form - parent material associations and topographic locations in adjacent Allen and Huntington Counties (3).

Ridge Moraine

The subdued ridge moraine found south of the Eel River generally coincides with the local drainage divides and exhibits

relief which ranges from about 25 to 40 feet. This ridge moraine lacks the numerous deposits of peat and muck which characterize the moraine north of the river and those found are scattered randomly and show no particular association with either ridge or ground moraine. The finer textured(A-4 to A-7) till found south of the Eel River does not exhibit the effects of stagnant ice mass and glacio - fluvial action found in the glacial drift north of the river.

The Rawson, Morley, and Glynwood or similar soil series developed on the swells and knolls of the ridge moraine in the Tipton Till Plain in Whitley County(3). The Rawson and Glynwood series are characterized by a sandy loam(A-2 to A-4) or silty clay - loam surface soil to a depth of about nine inches. A sandy clay - loam(A-4 to A-6) or silty clay - loam(A-6 to A-7) is found from nine to a depth of about 36 inches and is underlain by a clay loam or silty clay - loam (A-6 to A-7). The Morley series is characterized by 14 inches of a loam or silty clay - loam(A-4 to A-7) surface soil which is underlain to a depth of about 28 inches by clay or clay loam(A-7). Beneath 28 inches is a silty clay or silty clay - loam(A-6 to A-7) soil.

The Pewamo, Mermill, Blount, and Brookston or similar soil series are developed in the swales of the ridge moraine south of the Eel River(3). The Pewamo, Mermill, and Blount series are characterized by a loam, clay loam, or silt loam(A-4 to A-7) surface soil to a depth of about 10 to 12 inches. The Pewamo, Brookston, and Blount surface soils are underlain by a clay or

silty clay - loam(A-6 to A-7) soil to a depth of about 36 inches while the Mermill series surface soil is underlain by 34 inches of a loam or sandy clay - loam soil(A-4 to A-7). Beneath about 34 to 36 inches is a clay loam or silty clay - loam(A-6 to A-7) soil. Organic matter content of soils developed in the swales ranges from about two to five percent(17).

Ground Moraine

Wisconsinan ground moraine lies almost entirely south of the Eel River with only minor inclusions found north of the river. The ground moraine is nearly flat to gently undulating with local relief that seldom exceeds about 30 feet. Drainage is a problem in some areas due to a lack of adequate relief and the relatively impermeable nature of the ground moraine parent material, resulting in frequent temporary ponding, particularly during spring thaw and after periods of prolonged or heavy rainfall. Nishimura (18) concurs with these observations.

The Morley, Glynwood, and Miami or similar soil series developed on the swells of the ground moraine and are characterized by a loam, silt loam, or silty clay - loam(A-4 to A-7) surface soil to a depth of about 12 inches(3). Clay, silty clay, or silty clay - loam(A-6 to A-7) is found beneath the surface soil to a depth of approximately 28 inches. The Glynwood and Miami series are characterized by a sandy clay - loam, clay loam, or silty clay - loam(A-4 to A-6) soil beneath 28 inches. A clay loam or silty clay - loam(A-6 to A-7) is found beneath 28 inches in

areas of Morley series soils.

Swales in the ground moraine of Whitley County are occupied by the Blount, Pewamo, and Mermill or similar soil series(3). The surface soil of these series is a loam, sandy clay - loam, or silty clay - loam(A-4 to A-7) which extends to a depth of about 9 to 13 inches. The surface soil of the Blount and Pewamo series is underlain to a depth of 35 inches by a clay loam or silty clay soil(A-6 to A-7). The surface soil of the Mermill series is underlain by a loam or clay loam(A-4 to A-7) soil to a depth of about 35 inches. Beneath 35 inches is found a clay loam or silty clay - loam(A-6 to A-7) for all three soils.

Nishimura (18) conducted a grain size analysis of the parent material beneath elevated areas (knolls) and of the plastic or second (B) horizon in depressions of the Wisconsinan till associated with the Erie Lobe recessional moraines in northeastern Indiana. The results of this study are shown in Figure 12. Recall that the texture of ridge and ground moraine parent materials does not vary greatly between ridge and ground moraine within the Tipton Till Plain, consequently the grain size curves shown may be taken, in general, as representative of their respective sampling positions in both ridge and ground moraine south of the Eel River. Representative grain size curves for samples taken from similar positions in the till north of the river would probably be shifted somewhat to the left. In addition, Nishimura sites that dry densities at optimum water content range from about 90 to 120 lbs/ft^3 for soils and parent materials

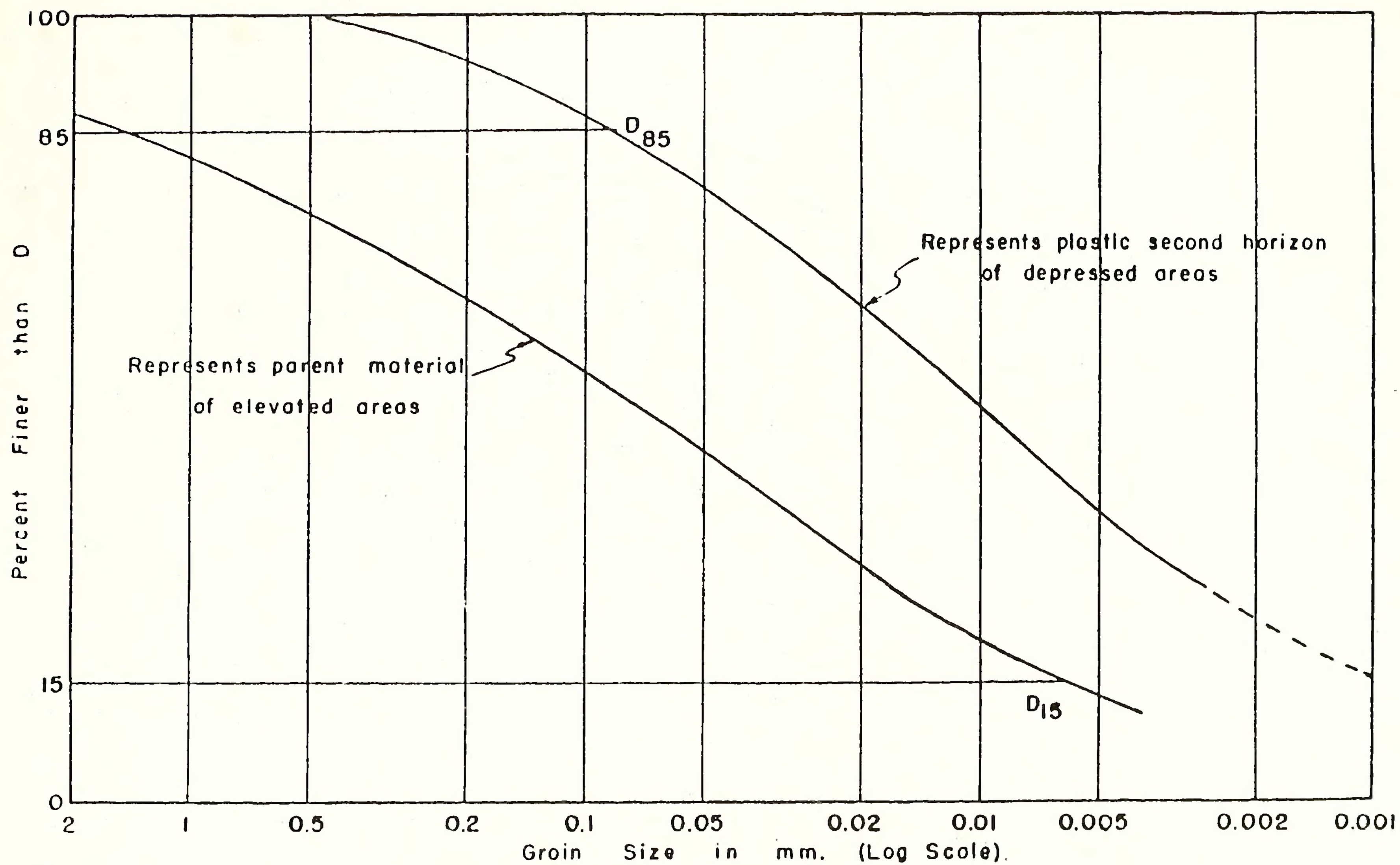


Figure 12. Mean Grain Size Distribution Curves for Soil Samples taken from the Positions Indicated in Wisconsin Moraines in Northeastern Indiana (18).

of the Wisconsinan till found south of the Eel River in Whitley County (18).

REGIONAL ENGINEERING SOIL AREAS

Regional engineering soils do not vary substantially in texture or properties north and south of the Eel river and are found throughout Whitley County. These soils developed in glacio - fluvial, alluvial, and depressional deposit parent materials. The agricultural soil series mentioned developed on similar land form - parent material associations in Noble, Allen, and Huntington Counties, Indiana (4).

Glacio - Fluvial Deposits

Glacio - fluvial deposits include any land form - parent material association composed of glacial drift deposited by Wisconsinan meltwater. Much of the sediment contained in these deposits was derived directly from the ice while some was recently deposited till which was subsequently eroded and redeposited by the meltwater of the receding Wisconsinan ice mass. Outwash terraces and glacial sluiceways formed primarily in front of the receeding ice while kames and eskers are thought to have formed in contact with stagnant ice masses.

Outwash Terraces

Discontinuous outwash terrace deposits are found adjacent to the Eel River along its entire course in Whitley County. The outwash terraces are more common and increase in size downstream toward the Kosciusko County Line, reaching a width of nearly 3/4

of a mile in sections 4, 5, 6, and 7, T30N, R8E. Elsewhere, the outwash terraces are generally less than 1/4 mile in width and are less continuous, commonly crossed or partially crossed by tributaries of the Eel River. The outwash terraces are located above the flood plains and recent river terraces and below the surrounding ridge, kettle - kame, and ground moraine and any associated water - reworked till (subsequently discussed).

The outwash terrace deposits in Whitley County are coarse textured, composed primarily of rounded sand and gravel with some silt and clay in the weathered, near - surface portion of the soil profile. Gravel content(by weight) in the underlying parent material ranges from less than 5 to more than 70 percent(4). Content of rock fragments three inches in size and greater ranges from 0 to 15 percent (17). Clay content in the B - horizon ranges from about 5 to 35 percent.

Agricultural soil series found on outwash terrace deposits in Noble, Allen, and Huntington Counties include the Warsaw, Oshtemo, Fox, Homer, Brady, and Gilford(4). The surface soil of the Brady, Gilford, Homer, and Fox series is a sandy loam or silt loam(A-2 to A-4) which extends to a depth of about 11 inches. The subsoil of the Fox, Homer and Gilford series is a silty clay - loam or clay loam(A-6 to A-7) or fine sandy loam(A-2-4) found from 11 to 25 inches. From 25 to about 40 inches is a clay loam(A-6) or sand or sandy clay - loam(A-2 to A-4) which is underlain by gravelly - sandy loam, sandy gravel, or gravelly sand(A-1 to A-3). The Warsaw and Oshtemo soil series are

characterized by a silt loam or sandy loam(A-2 to A-4) surface soil to a depth of 14 to 17 inches. The subsoil of the Warsaw, Oshtemo, and Brady series is a gravelly loam, sandy loam, or sandy clay - loam(A-2 to A-6) which extends from a depth of 17 inches to about 35 inches. Beneath 35 inches is gravelly sand, loamy sand, or sandy loam(A-1 to A-3).

Generally speaking, the surface soil of the outwash terraces is a silt loam or sandy loam(A-2 to A-4) which extends to a depth of about 10 to 17 inches. The soil of the B - horizon or zone of clay accumulation is commonly a sandy loam, sandy clay - loam, or clay loam(A-2 to A-7) ranging in depth from 17 to 35 inches. The underlying parent material is generally gravelly sand, sandy gravel, or gravelly - sandy loam(A-1 to A-3).

Sluiceways over Terraces

Although not common, sluiceways and sluiceway - like streams do meander over outwash and recent river terraces as well as water - reworked till in Whitley County. These sluiceways may be of meltwater origin or they may be associated with present day streams. The soil profiles of small streams with well developed channels which are shown crossing terraces on the map which accompanies this report and the less well defined, transient flow channels of streams which are shown entering but not crossing terraces are similar to the general profile developed from the pedalogical soil series data for sluiceways over terraces. The profile shown on the engineering soils map of Whitley County

engineering soils map is representative of both sluiceways and small stream channels over terrace deposits.

The Oshtemo(loamy substratum), Rensselaer Variant, Sebewa, and Whitaker Variant pedalogical soil series developed on sluiceway and small stream deposits over terraces in adjacent Noble, Allen, and Huntington Counties(4). The Oshtemo, Sebawa, and Whitaker Variant soils are characterized by 8 to 14 inches of a loam, sandy loam, or silty clay - loam(A-2 to A-4) surface soil which is underlain to a depth of 36 to 56 inches by a sandy clay - loam, sandy loam, or gravelly clay - loam(A-2 to A-6) subsoil. The subsoil is underlain by sand, gravelly sand, or gravelly - sandy loam(A-1 to A-3). The surface soil of the Rensselaer Variant soil series is a loam which extends to a depth of about 10 inches. A clay loam(A-6 to A-7) subsoil extends to a depth of about 16 inches and is underlain by fine sandy loam or fine sand(A-2 to A-4) to approximately 60 inches. Gravel content ranges up to 10 percent in the developed soil profile(17).

Glacial Sluiceways over Till

Glacial sluiceways over till are found throughout Whitley County. Those to the north of the Eel River are typically short (ie., less than 1.5 miles in length) and are commonly associated with present day, interbasin overflow channels, while those to the south of the river are as much as five miles long and are associated with streams, particularly in their upper reaches near the drainage divides. Although the course of the Eel River once

acted as a giant sluiceway, the author herein differentiates it from the numerous smaller sluiceways over till found in Whitley County based on size and the greater textural variation, particularly laterally, within the Eel River Valley deposits. The sluiceways shown on the engineering soils map within ridge, kettle - kame, and ground moraine may not all be water courses formed primarily by meltwater, however, they were mapped as such based on sampling experience and color tone, textural pattern, relief, and location with respect to the surrounding deposits on the aerial photographs.

The Aubbeenaubbee, Crosier, Rensselaer, and Haskins agricultural soil series developed on glacial sluiceway sediment over till in adjacent Noble, Allen, and Huntington Counties(4), and are similar to soils developed on sluiceways in Whitley County. The surface soil of these series is characteristicly a loam, loamy sand, or fine - sandy loam(A-2 to A-6) which extends to a depth of about 11 inches. The texture of the subsurface soils varies greatly with depth, indicative of shallow water, stream - like deposition. From 11 to about 25 to 30 inches is a loam, clay loam, or silty clay - loam(A-6 to A-7) where Crosier or Rensselaer soils are found. In areas of Aubbeenaubbee, Haskins, or similar soils, the subsoil is a loam or sandy loam(A-2 to A-6) which extends to a depth of about 22 to 31 inches. Beneath a depth of 31 inches is found clay loam, silty clay - loam, or sandy clay - loam(A-4 to A-6) which contains intermixed layers of loam or sandy loam(A-2 to A-4).

Kames and Eskers

Kames and eskers are fluvial deposits of glacial origin which are thought to form in association with stagnant ice masses. Kames are rounded knolls to irregularly shaped mounds of meltwater sands and gravels. Eskers are relatively long, narrow, sinuous ridge - like deposits of glacio - fluvial sand and gravel.

Kames are far more numerous north of the Eel River in Whitley County and rise as much as 60 to 80 feet above the local base level while the few found south of the river are confined primarily to the small areas of ridge and kettle - kame moraine adjacent to the river. Although relatively prominent sandy knolls exist in the Tipton Till Plain region of Whitley County, none were determined to be sand and gravel deposits of glacio - fluvial origin. North of the river, kame - like knolls are so numerous that differentiating them from the true kames on the aerial photographs was not always possible and field varification was impractical. Consequently, only the most prominent knolls were mapped as kames and some of these may not be true kames due to the lack of field varification time while some kames may have gone unidentified.

Eskers are, in general, less common than kames and are usually much longer than they are wide and rise only about 20 to 40 feet above the surrounding land surface. Several small eskers, or coarse textured esker - like features ranging up to about 1/2

mile in length are found in Whitley County. The most prominent of these are located in the following sections: section 6, T32N, R9E; sections 26 and 36, T32N, R8E, and section 16, T31N, R10E.

Similar soils develop on kames and eskers. The Boyer, Casco, Fox, and Oshtemo soil series developed on kames and/or eskers in Noble County to the north of Whitley County(2). The Boyer and Oshtemo series are characterized by 18 inches of a loam or sandy loam(A-1 to A-4) surface soil which is underlain to a depth of about 34 inches by loam, sandy clay - loam, or gravelly - sandy loam(A-2 to A-6). Gravelly sand, sandy loam, and gravel(A-1 to A-3), the parent materials of kames and eskers are found beneath the subsoil. The Casco soils series is similar to the Boyer and Oshtemo series and is characterized by eight inches of a loam, sandy loam, or gravelly - sandy loam(A-1 to A-4) surface soil. A clay loam, sandy clay - loam, or gravelly loam (A-2 to A-7) subsoil extends to a depth of about 17 inches and is underlain by stratified sand and gravel(A-1 to A-3). The surface soil of the Fox series is a sandy loam or gravelly loam(A-2 to A-6) which extends to a depth of 11 inches. Silty clay - loam, silt loam, or clay loam(A-6 to A-7) is found from 11 to 22 inches and is underlain to a depth of 34 inches by clay loam, loam, or sandy clay - loam(A-2 to A-7). Beneath 34 inches lies the stratified sand and gravel (A-1 to A-3) parent material of the kame or esker.

Soil slopes range from 0 to 70 percent or more on kames and eskers(17). The Boyer, Casco, Oshtemo, and Fox surface soils

contain up to 15 percent gravel and 10 percent rock fragments larger than three inches by weight.

Fluvial Deposits

Flood Plains

Flood plains are found along the Eel River and its major tributaries, particularly Spring Creek, Clear Creek, the Blue River, and Sugar Creek in Whitley County, Indiana. The flood plains range from less than 200 feet in width to as much as a half a mile at the junctions of the major streams. The flood plains generally decrease in width toward the drainage divides, in some places narrowing to sluiceway - like channels and commonly cross deposits of peat and muck or organic lacustrine plains.

Flood plain soils are primarily composed of silt, clay and fine sand and generally exhibit poorly defined soil horizons while the parent material commonly contains coarse sand and some gravel. The Eel, Genesee, Shoals, and Sloan soils developed on the flood plains in surrounding counties and are all characterized by similar soil texture and profile development(4). The surface soil and subsoil of the Eel, Genesee, and Shoals soil series is a silt loam, loam, or silty clay - loam(A-4 to A-6) which extends to a depth of about 34 inches. Beneath 34 inches is a silt loam, silty clay - loam, or fine sandy loam(A-4 to A-6). The Sloan series is characterized by a loam, silt loam, or clay -

loam (A-4 to A-7) soil to a depth of about 45 inches beneath which is found gravelly - fine sandy clay - loam or silty clay - loam(A-4 to A-6).

Permeability of the flood plain soils is generally poor to moderate, ranging from about 0.2 to 2.0 inches per hour in the developed soil profile (17). The flood plain soils contain from 10 to 35 percent clay by weight and are typically characterized by plasticity indecies that range from 3 to about 20.

Recent River Terraces

Recent river terrace deposits are located adjacent to the flood plains of present day streams and are composed of recently eroded and redeposited sediment and reworked glacio-fluvial material left by the Wisconsinan meltwaters. These deposits are found along the Eel River and its major tributaries. The recent river terraces are located above the flood plains and below the outwash terraces topographically and are commonly associated with areas of water - reworked till.

The sand, silt, and gravel parent material of the recent river terraces is similar to that of the outwash terraces, although the sediment may be more rounded, better sorted, and the average particle size somewhat smaller. Consequently, the soils which developed on both types of terraces are similar, however, the outwash terrace soils are generally leached of clay and weathered to a greater depth due to the greater age of their

parent material.

The Fox, Westland, Rensselaer, and Plainfield or similar soil series developed on the recent river terraces in Whitley County(4). The Westland, Fox, and Rensselaer series are characterized by a loam, silt loam, or silty clay - loam(A-4 to A-7) surface soil to a depth of about 11 to 15 inches. Between 15 and about 40 inches is found clay loam, silty clay - loam, or sandy clay - loama(A-4 to A-7) which is underlain by fine sand, sandy gravel, or sandy clay - loam(A-1 to A-4). The Westland soil series is characterized by clay loam or gravelly clay - loam(A-6 to A-7) from 15 to about 50 inches of depth which is underlain by stratified sand and gravel(A-1 to A-3). The entire soil profile of the Plainfield series consists of sand, loamy sand, and fine sand(A-1 to A-3).

Permeability of the recent river terrace deposits ranges from 0.2 to 2.0 inches per hour for the surface soil profile and up to 20.0 inches per hour for the underlying parent material(17). Gravel content ranges from 5 to 35 percent by weight while fragments larger than three inches compose from zero to 10 percent of the recent river terrace material.

Water - Reworked Till Deposits

Areas of water - reworked till are found throughout Whitley County where water intermittently flows over ridge, ground, or kettle - kame moraine. These deposits are the result of a sheet

wash or scouring effect wherein the fines are removed and little deposition occurs, resulting in terrain which exhibits the rounded form of land over which water occasionally flows and a surface soil which is somewhat coarser than that of the surrounding unaffected land. Water - reworked till is located above the flood plains and any recent river or outwash terraces and is associated with stream coarses and sluiceway channels in Whitley County, particularly at sharp bends or narrow points where overflow channels develop and at the junctions of major streams. Large areas of water - reworked till, up to 3/4 of a mile wide, are found at the junction of the Eel River with Stony and Sugar Creeks and with Spring and Clear Creeks and the Blue River. The largest areas are probably remnant effects of Wisconsinan meltwater which scoured the valley walls during peak periods of post - glacial flooding.

Soils which developed in areas of water - reworked till are similar to sluiceway soils and include the Aubbeenaubbee and Haskins or similar soil series(4). These soils are characterized by 10 inches of a loamy sand or fine sandy loam(A-2 to A-4) surface soil which is underlain by loam or sandy loam (A-2 to A-6) to a depth of about 26 inches. Beneath 26 inches is found clay loam, sandy clay - loam or silty clay - loam(A-4 to A-6).

Slopes range from about zero to six percent in areas of till which are frequently reworked by water, however, valley sideslopes which are intermitently scoured by water may be as steep 40 percent or greater(4). In general, the till affected by

the water reaches to a depth of only about two to three feet and is characterized by a permeability of 0.6 to 6.0 inches per hour. The permeability of the underlying till ranges from about 0.2 to only about 2.0 inches per hour(17).

Depressional Deposits

Peat and Muck

Deposits of peat and muck, although found primarily north of the Eel River, are scattered throughout Whitley County in depressional areas. Deposits of peat and muck located in kettle - kame moraine are considered primarily of kettle origin, while most others developed in depressions of inconsequential origin. Sapric(organic) soils are found primarily in the kettle - kame and ridge moraine north of the Eel River and are commonly associated with organic lacustrine plains and glacial lakes in that region. South of the river, the deposits of peat and muck are apparently distributed randomly, exhibiting little or no association with either ridge or ground moraine, or any other land form. Peat and muck is commonly found in low - lying areas along existing streams and old sluiceway channels in Whitley County. Many of the peat and muck areas are drained and used for agricultural purposes. Other drained areas are put to commercial use for the growing of sod for landscaping and as source areas of organic matter for potting and backyard gardening use.

The Palms, Houghton, and Adrian or similar soil series developed in deposits of peat and muck of non - kettle origin in

Whitley County(4). The Palms and Adrian series are probably more characteristic of such deposits and typically exhibit a sapric surface soil(peat and muck , A-8) to a depth of about 35 inches. The Adrian series is characterized by a sandy(A-3) subsoil while the organic surface soil of the Palms series is underlain by clay loam, silty clay - loam, or fine - sandy loam(A-4 to A-6). The Houghton soil series, though more typical of the deeper kettle organic deposits, is found in other deposits of cumulous drift as well. It is characterized by peat and muck(A-8) which reaches to a depth of 66 inches or more and is underlain by the parent material of the surrounding land form. The content of organic matter in these deposits ranges from about 55 to more than 75 percent(17).

Highly Organic Topsoil

Deposits of highly organic topsoil are found randomly scattered throughout Whitley County in shallow swales in the glacial till of the ridge, kettle - kame and ground moraine. Highly organic topsoil is commonly associated with low - lying areas along stream courses and is also found on the fringes of organic lacustrine plains, lakes, and deposits if peat and muck.

The Milford, Toledo, and Pewamo or similar soil series developed in deposits of peat and muck in Whitley County(4). The Toledo and Milford series are associated with lacustrine deposits and are characterized by silty clay - loam, clay loam, silty clay, and silt loams(A-6 to A-7) throughout their profiles. Sandy

loams(A-4) occur as lenses within these soil series, particularly beneath the upper 30 to 45 inches or so. The Pewamo series develops primarily in large depressions in ground and ridge moraine and is characterized by silt loam, clay loam, or silty clay - loam(A-6 to A-7) soil throughout the profile. The Pewamo series is similar in many respects to the Milford and Toledo series, however, it lacks the stratified lenses of sandy loam which are characteristics of the sheet - wash effect and the lacustrine depositional environment associated with the parent material of the Milford and Toledo soil series. Organic matter content ranges from three to about six percent or more in deposits of highly organic topsoil(17).

Miscellaneous Soil Areas

Slackwater Lacustrine Over Outwash

A small area (less than 1/4 square mile) in the southeast corner of the county along the Little Wabash River is apparently a rather complex assemblage of poorly stratified lacustrine silts, clays, and fine sands over granular Wisconsinan outwash. D. G. Shurig(22) notes that borings along I - 69 in Allen County along the southern valley wall of the Little Wabash River indicate a clay or clay loam soil extends to a depth of about six feet and is underlain by sand or loamy sand. The Lenawee and Montgomery pedalogical soil series are found on the slackwater lacustrine plain as identified on the Allen County (agricultural) Soil Survey(3a).

This author interpreted the area between the Little Wabash River and its northern valley wall (in Whitley County) on the aerial photographs as more of a flood plain - like deposit. However, due to a lack of borehole information and the adopted mapping format which necessitates the correlation of all mapping units across county lines, the standard lacustrine symbol is shown on the Whitley County map from the northern valley wall of the Little Wabash River to the southeast corner of the map. Shurig notes that the Little Wabash River Valley once acted as a major meltwater channel at the end of the Wisconsinan glaciation, resulting in the large valley seen and leaving only the underfit stream known as the Little Wabash River which occupies the valley

today. The borehole information available for the southern valley wall of the Little Wabash certainly indicates lacustrine deposition of some form, probably slackwater in nature. The agitated depositional mode of a shallow - water, slackwater lacustrine environment may explain the current marks observed on the aerial photographs. The 'ebb and flow' - like motion of water in an area of slackwater deposition and the intermittent periods of relatively high energy flow during times of flooding are probably responsible for the current markings seen on the aerial photographs.

Soil Borings

Roadway soil survey borehole information for Whitley County was sparse, confined primarily to areas of alluvial deposition where soil profile information was needed for bridge replacement and repair work. The borehole information available was not referred to in the development of the general soil profiles and descriptions of the flood plain and terrace deposits in the report due to the high variability of alluvial soils both laterally and vertically(i.e., the soil information is site - specific). However, the alluvial borehole data found is tabulated in Appendix A in the back of this report as a supplement to the general descriptions and engineering characteristics of the flood plain and terrace deposits found in the text of the report and in Appendix B, respectively.

Some soil borings were made along S.R. 30 mear the central

portion of the county where a small landslide occurred. The borings indicated a two to three foot thick layer of peat and muck at a depth ranging from about eight to 14 feet which was sandwiched between stratified glacial sands and gravels. A stability analysis concluded failure occurred along the weak, highly compressive zone of peat and muck.

Sand and Gravel Pits

Sand and gravel pits found on the 1951 aerial photographs are identified on the accompanying map by the symbol shown under miscellaneous on the map legend. Most of the pits were located along the Eel River and increased in number toward the Kosciusco County Line. Sand and gravel pits were also found along Spring Creek and the Blue River and were clustered downstream from their junctions with the Eel River. In general, the pits on the smaller tributaries and on the flood plain of the Eel River probably produced primarily sand while those on recent river and outwash terraces yielded greater amounts of gravel.

Many of the pits shown on the map may no longer be in operation and pits opened after 1951 are not shown. However the pits shown on the map indicate where sand and gravel were found in the past and where this valuable construction material may likely be found in the future. L. C. Ward(19) claimed an extensive deposit of sand and gravel underlies much of Whitley County beneath a blanket of till which ranges up to 100 feet or more in thickness. The literature review conducted during the course of this study

yielded no further documentation supporting Ward's claim and the author found no surficial evidence in the field suggesting such an extensive deposit of sand and gravel exists in Whitley County, however, lack of field evidence and supportive literature does not necessarily mean that such a subsurface deposit does not in fact exist. Further investigation is needed to varify or nullify Ward's claim and such a study will not likely be undertaken until the extensive near - surface deposits of sand and gravel deposits are exhausted, which probably won't take place for quite some time.

Boulder Belt

J. H. Shiltz(13) identified an area in the east - central part of Whitley County wherein boulders appeared to be far more numerous than elsewhere in the county. The boulders ranged up to six feet in diameter and were most commonly granitic in origin.

The boulder belt, as Shiltz defined it, is about one half to one mile in width and stretches from section 34, T32N, R10E in a southwesterly direction to section 32, T31N, R10E, a distance of about seven miles(13). Shiltz additionally observed intermittent evidence indicating the belt extends further in a southwesterly direction. The author found that cobbles and boulders are generally more numerous north of the Eel River, particularly on the knolls in the ridge and kettle - kame moraine. However, he was not aware of Shiltz's 'boulder belt' at the time of his field trip and is unable to herein independently varify its presence in Whitley County.

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Appendix A. Engineering Properties and Characteristics of Selected Representative Pedological Soil Series for the Engineering Soil - Land Form Associations of Whitley County, Indiana(17).

Pedalogical soil series for land form - parent material associations north of the Eel River.

Land Form	Topographic Position	Representative Pedalogical Soil Series
Kettle - Kame Moraine	high(till Knob) low(kettle)	Rawson Variant Houghton
Ridge Moraine	high low	Rawson Variant Parr
Organic Lacustrine Plain	low	Edwards
Alluvium over Organic Lacustrine Plain	low	Wallkill (clayey substratum)
Beaches	high	Belmore

Pedalogical soil series for land form - parent material associations south of the Eel River.

Land Form	Topographic Position	Representative Pedalogical Soil Seri
Ridge Moraine	high low	Morley Blount
Ground Moraine	high low	Morley Pewamo
Slackwater Lacustrine Plain over Outwash Valley Train	low	Montgomery (gravelly substratum)

Pedalogical soil series for Regional land form - parent material associations.

Land Form	Topographic Position	Representative Pedalogical Soil Series
outwash terrace	intermediate	Warsaw
sluiceway over till	low	Aubbeenaubbee
sluiceway over terrace	low	Sebewa
kames and eskers	high	Casco
flood plains	low	Eel
recent river terraces	low intermediate	Plainfield
water - reworked till	high intermediate	Haskins
peat and muck	low	Houghton
highly organic topsoil	low	Pewamo

THE AUBBEENAUBBEE SERIES CONSISTS OF DEEP, SOMEWHAT POORLY DRAINED SOILS FORMED IN LOAMY GLACIOFLUVIUM AND THE UNDERLYING LOAM GLACIAL TILL ON MORAINES AND TILL PLAINS. THE SURFACE LAYER IS DARK GRAYISH BROWN FINE SANDY LOAM 8 INCHES THICK. THE SUBSURFACE LAYER IS GRAYISH BROWN FINE SANDY LOAM 7 INCHES THICK. THE MOTTLED SUBSOIL IS YELLOWISH BROWN FINE SANDY LOAM IN UPPER 6 INCHES, DARK GRAYISH BROWN SANDY CLAY LOAM IN NEXT 6 INCHES AND YELLOWISH BROWN AND GRAYISH BROWN CLAY LOAM IN LOWER 13 INCHES. THE SUBSTRATUM IS BROWN MOTTLED LOAM. SLOPES ARE 0 TO 6 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-15	SL, FSL	SM, SM-SC	A-2-4, A-4	0	100	90-100	50-85	30-50	<25	NP-6
15-27	SL, SCL, FSL	SM, ML, SM-SC, CL-ML	A-2-4, A-4	0	100	90-100	50-90	25-55	15-30	3-10
27-40	CL, L	CL	A-6, A-4	0	95-100	85-100	75-100	55-80	25-35	9-14
40-60	L	CL, CL-ML	A-4	0-3	90-100	85-100	75-100	55-80	20-30	5-10

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-15	8-15	1.45-1.55	0.6-6.0	0.12-0.18	5.6-7.3	-	LOW	.24	5	3	1-2	HIGH	MODERATE
15-27	10-25	1.55-1.65	0.6-6.0	0.11-0.16	5.1-6.5	-	LOW	.24					
27-40	22-32	1.40-1.65	0.2-0.6	0.14-0.18	5.6-7.3	-	MODERATE	.32					
40-60	15-24	1.70-1.95	0.2-0.6	0.05-0.12	7.4-8.4	-	LOW	.32					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			1.0-3.0	APPARENT	JAN-APR	-		>60		-		B	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS, PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-SEEPAGE, WETNESS
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS
SANITARY LANDFILL (AREA)	SEVERE-SEEPAGE, WETNESS
DAILY COVER FOR LANDFILL	POOR-WETNESS

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS
LOCAL ROADS AND STREETS	SEVERE-FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	MODERATE-WETNESS

CONSTRUCTION MATERIAL

ROADFILL	FAIR-WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	FAIR-SMALL STONES

WATER MANAGEMENT

POND RESERVOIR AREA	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING, WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-SLOW REFILL
DRAINAGE	0-3%: FROST ACTION 3+%: FROST ACTION, SLOPE
IRRIGATION	0-3%: WETNESS, SOIL BLOWING 3+%: WETNESS, SLOPE, SOIL BLOWING
TERRACES AND DIVERSIONS	WETNESS, SOIL BLOWING
GRASSED WATERWAYS	WETNESS

TYPIC HAPLUDALFS, FINE-LOAMY, MIXED, MESIC

THE BELMORE SERIES CONSISTS OF DEEP, WELL DRAINED SOILS FORMED IN LOAMY OVER GRAVELLY, SANDY AND LOAMY SEDIMENTS ON BEACH RIDGES, TERRACES AND OUTWASH PLAINS. THE SURFACE LAYER IS DARK GRAYISH BROWN LOAM 7 INCHES THICK. THE SUBSURFACE LAYER IS YELLOWISH BROWN LOAM 4 INCHES THICK. THE SUBSOIL IS DARK BROWN SANDY CLAY LOAM AND GRAVELLY SANDY CLAY LOAM 25 INCHES THICK. THE SUBSTRATUM IS PALE BROWN GRAVELLY LOAM AND GRAVELLY SANDY LOAM. SLOPES RANGE FROM 0 TO 50 PERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-11	L, SIL	ML, CL-ML, CL	A-4	0	85-100	80-100	60-90	50-80	20-32	3-10
0-11	SL, FSL	ML, SM, CL-ML, SM-SC	A-4	0	85-100	80-100	50-90	40-55	<25	NP-6
11-25	SCL, CL, SL	SC, SM-SC, CL, CL-ML	A-4, A-6	0	85-100	80-100	55-75	40-70	20-36	8-18
25-36	GR-SCL, GR-CL, GRV-SL	SC, CL	A-6, A-4, A-2	0	80-100	45-80	30-80	15-65	25-40	7-15
36-60	GR-SL, GR-L, GRV-SL	SM, SC, SM-SC, ML	A-2, A-4, A-1	0	80-100	50-80	30-75	15-60	15-30	NP-10

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-11	10-24	1.30-1.45	0.6-2.0	0.14-0.18	5.6-7.3	-	LOW	.32	4	5	1-3	MODERATE	MODERATE
0-11	8-15	1.20-1.45	2.0-6.0	0.10-0.13	5.6-7.3	-	LOW	.24	4	3	1-3		
11-25	15-30	1.35-1.60	2.0-6.0	0.10-0.14	4.5-7.3	-	LOW	.32					
25-36	18-35	1.40-1.60	2.0-6.0	0.12-0.16	5.6-7.8	-	LOW	.32					
36-60	5-15	1.50-1.70	6.0-20	0.08-0.12	7.4-8.4	-	LOW	.24					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-15%: SEVERE-POOR FILTER 15+%: SEVERE-SLOPE, POOR FILTER
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SLOPE, SEEPAGE
SANITARY LANDFILL (TRENCH)	0-15%: SEVERE-SEEPAGE 15+%: SEVERE-SEEPAGE, SLOPE
SANITARY LANDFILL (AREA)	0-15%: SEVERE-SEEPAGE 15+%: SEVERE-SLOPE, SEEPAGE
DAILY COVER FOR LANDFILL	0-8%: GOOD 8-15%: FAIR-SLOPE 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: GOOD 15-25%: FAIR-SLOPE 25+%: POOR-SLOPE
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	0-15%: POOR-THIN LAYER, SMALL STONES 15+%: POOR-SLOPE, THIN LAYER, SMALL STONES

WATER MANAGEMENT

POND RESERVOIR AREA	0-8%: SEVERE-SEEPAGE 8+%: SEVERE-SEEPAGE, SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-SEEPAGE, PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3% L, SIL: FAVORABLE 3+% L, SIL: SLOPE 0-3% SL, FSL: SOIL BLOWING 3+% SL, FSL: SOIL BLOWING, SLOPE
TERRACES AND DIVERSIONS	0-8% L, SIL: FAVORABLE 8+% L, SIL: SLOPE 0-8% SL, FSL: SOIL BLOWING 8+% SL, FSL: SLOPE, SOIL BLOWING
GRASSED WATERWAYS	0-8%: FAVORABLE 8+%: SLOPE

THE BLOUNT SERIES CONSISTS OF SOMEWHAT POORLY DRAINED SOILS FORMED IN GLACIAL TILL. THE SURFACE LAYER IS DARK GRAY SILT LOAM 7 INCHES THICK. THE SUBSURFACE LAYER IS GRAYISH BROWN SILT LOAM 3 INCHES THICK. THE SUBSOIL IS LIGHT YELLOWISH BROWN, YELLOWISH BROWN AND LIGHT BROWNISH GRAY SILTY CLAY LOAM AND SILTY CLAY 22 INCHES THICK. THE SUBSTRATUM IS LIGHT YELLOWISH BROWN SILTY CLAY LOAM. SLOPE RANGES FROM 0 TO 6 PERCENT. AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-10	SIL, L	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
10-32	SICL, SIC, CL	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
32-60	SICL, CL	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-10	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	-	LOW	.43	3	6	2-3	HIGH	HIGH
10-32	35-50	1.40-1.70	0.06-0.6	0.12-0.19	4.5-6.5	-	MODERATE	.43					
32-60	27-38	1.60-1.85	0.06-0.6	0.07-0.10	7.4-8.4	-	MODERATE	.43					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			1.0-3.0	PERCHED	JAN-MAY	-		>60		-		C	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS, PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-WETNESS
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS
SANITARY LANDFILL (AREA)	SEVERE-WETNESS
DAILY COVER FOR LANDFILL	POOR-WETNESS

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH, FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	MODERATE-WETNESS

CONSTRUCTION MATERIAL

ROADFILL	POOR-LOW STRENGTH
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-THIN LAYER

WATER MANAGEMENT

POND RESERVOIR AREA	0-3%: SLIGHT 3-6%: MODERATE-SLOPE
EMBANKMENTS DIKES AND LEVEES	MODERATE-PIPING, WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	0-3%: PERCS SLOWLY, FROST ACTION 3+%: PERCS SLOWLY, FROST ACTION, SLOPE
IRRIGATION	WETNESS, PERCS SLOWLY
TERRACES AND DIVERSIONS	ERODES EASILY, WETNESS, PERCS SLOWLY
GRASSED WATERWAYS	WETNESS, ERODES EASILY

TYPIC HAPLUDALFS, FINE-LOAMY OVER SANDY OR SANDY-SKELETAL, MIXED, MESIC

THE CASCO SERIES CONSISTS OF WELL DRAINED AND SOMEWHAT EXCESSIVELY DRAINED SOILS FORMED IN LOAMY DEPOSITS OVER SAND AND GRAVEL ON OUTWASH PLAINS, STREAM TERRACES, ESKERS, KAMES AND MORAINES. THE SURFACE LAYER IS DARK GRAYISH BROWN LOAM 8 INCHES THICK. THE DARK BROWN SUBSOIL IS 5 INCHES OF CLAY LOAM AND 4 INCHES OF SANDY CLAY LOAM. THE SUBSTRATUM IS BROWN STRATIFIED SAND AND GRAVEL. SLOPES RANGE FROM 0 TO 70 PERCENT. THE LESS SLOPING AREAS ARE USED FOR CROPLAND AND STEEPER AREAS ARE USED FOR PASTURELAND, HAYLAND AND WOODLAND.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-8	L, SIL	ML, CL-ML, CL	A-4	0	95-100	90-100	75-100	55-90	20-30	3-10
0-8	SL, FSL	SM, SM-SC, ML, CL-ML	A-4, A-2	0	95-100	90-100	55-85	25-55	<20	2-7
8-17	CL, SCL, GR-L	SC, CL, GC	A-6, A-7, A-2	0-5	60-100	55-100	45-100	20-80	25-46	11-26
17-60	SR-S-G	GP, SP, GP-GM, SP-SM	A-1, A-3, A-2	0-10	30-100	30-100	10-95	2-10	-	NP

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-8	10-20	1.35-1.55	0.6-2.0	0.19-0.24	5.6-7.3	-	LOW	.32	3	5	1-3	MODERATE	LOW
0-8	5-15	1.40-1.70	0.6-2.0	0.12-0.18	5.6-7.3	-	LOW	.24	3	3	1-2		
8-17	18-35	1.55-1.65	0.6-2.0	0.09-0.19	5.6-7.8	-	MODERATE	.32					
17-60	0-2	1.30-1.80	>20	0.02-0.04	7.4-8.4	-	LOW	.10					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-15%: SEVERE-POOR FILTER 15+%: SEVERE-SLOPE,POOR FILTER
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE,SLOPE
SANITARY LANDFILL (TRENCH)	0-15%: SEVERE-SEEPAGE,TOO SANDY 15+%: SEVERE-SEEPAGE,SLOPE,TOO SANDY
SANITARY LANDFILL (AREA)	0-15%: SEVERE-SEEPAGE 15+%: SEVERE-SLOPE,SEEPAGE
DAILY COVER FOR LANDFILL	POOR-TOO SANDY,SEEPAGE,SMALL STONES

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-15%: SEVERE-CUTBANKS CAVE 15+%: SEVERE-CUTBANKS CAVE,SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8%: MODERATE-DROUGHTY 8-15%: MODERATE-SLOPE,DROUGHTY 15+%: SEVERE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: GOOD 15-25%: FAIR-SLOPE 25+%: POOR-SLOPE
SAND	PROBABLE
GRAVEL	PROBABLE
TOPSOIL	0-15%: POOR-AREA RECLAIM,SMALL STONES 15+%: POOR-SLOPE,AREA RECLAIM,SMALL STONES

WATER MANAGEMENT

POND RESERVOIR AREA	0-8%: SEVERE-SEEPAGE 8+%: SEVERE-SEEPAGE,SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-SEEPAGE
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3% L,SIL: DROUGHTY 3+% L,SIL: DROUGHTY,SLOPE 0-3% SL,FSL: DROUGHTY,SOIL BLOWING 3+% SL,FSL: SLOPE,DROUGHTY,SOIL BLOWING
TERRACES AND DIVERSIONS	0-8% L,SIL: TOO SANDY 8+% L,SIL: SLOPE,TOO SANDY 0-8% SL,FSL: TOO SANDY,SOIL BLOWING 8+% SL,FSL: SLOPE,TOO SANDY,SOIL BLOWING
GRASSED WATERWAYS	0-8%: DROUGHTY 8+%: DROUGHTY,SLOPE

THE EDWARDS SERIES CONSISTS OF VERY POORLY DRAINED SOILS FORMED IN ORGANIC MATERIAL OVER MARL IN DEPRESSIONS WITHIN OUTWASH, LAKE AND TILL PLAINS. THE SURFACE SOIL IS BLACK MUCK 32 INCHES THICK. THE SUBSTRATUM IS LIGHT GRAY MARL. SLOPES ARE 0 TO 2 PERCENT. AREAS ARE USED FOR PASTURELAND, WOODLAND AND CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-32	SP. MUCK	PT	A-8	0						
32-60	MARL			0	100	95-100	80-90	60-80		

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND ERODIBILITY GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-32	-	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.8	-		-	2	2	55-75	HIGH	LOW
32-60					7.4-8.4	-		-					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			+1-0.5	APPARENT	SEP-JUN	-		>60		4-12	25-30	B/D	HIGH

SANITARY FACILITIES	
SEPTIC TANK ABSORPTION FIELDS	SEVERE-PONDING,PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-PONDING,SEEPAGE,EXCESS HUMUS
SANITARY LANDFILL (TRENCH)	SEVERE-PONDING
SANITARY LANDFILL (AREA)	SEVERE-PONDING,SEEPAGE
DAILY COVER FOR LANDFILL	POOR-PONDING,EXCESS HUMUS

BUILDING SITE DEVELOPMENT	
SHALLOW EXCAVATIONS	SEVERE-PONDING,EXCESS HUMUS
DWELLINGS WITHOUT BASEMENTS	SEVERE-PONDING,LOW STRENGTH
DWELLINGS WITH BASEMENTS	SEVERE-PONDING,LOW STRENGTH
SMALL COMMERCIAL BUILDINGS	SEVERE-PONDING,LOW STRENGTH
LOCAL ROADS AND STREETS	SEVERE-PONDING,FROST ACTION,LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-EXCESS HUMUS,PONDING

CONSTRUCTION MATERIAL	
ROADFILL	POOR-WETNESS,LOW STRENGTH
SAND	IMPROBABLE-EXCESS HUMUS
GRAVEL	IMPROBABLE-EXCESS HUMUS
TOPSOIL	POOR-WETNESS,EXCESS HUMUS

WATER MANAGEMENT	
POND RESERVOIR AREA	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PONDING
EXCAVATED PONDS AQUIFER FED	SEVERE-SLOW REFILL
DRAINAGE	FROST ACTION,PONDING,SUBSIDES
IRRIGATION	PONDING,SOIL BLOWING
TERRACES AND DIVERSIONS	PONDING,SOIL BLOWING
GRASSED WATERWAYS	WETNESS

MLRA(S): 98, 99, 110, 111, 114, 115, 120, 121, 122

REV. GAW, 2-83

AQUIC UDIFLUVENTS, FINE-LOAMY, MIXED, NONACID, MESIC

THE EEL SERIES CONSISTS OF DEEP, MODERATELY WELL DRAINED SOILS FORMED IN ALLUVIUM ON BOTTOMLANDS. THE SURFACE LAYER IS BROWN SILT LOAM 8 INCHES THICK. THE SUBSTRATUM IS 8 INCHES OF BROWN SILT LOAM OVER 16 INCHES OF BROWN MOTTLED SILT LOAM OVER DARK GRAYISH BROWN MOTTLED STRATIFIED LOAM, SILTY CLAY LOAM AND SANDY LOAM. SLOPES ARE 0 TO 2 PERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLAS-TICITY INDEX
0-8	SIL, L	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	24-40	3-15
0-8	SICL	CL	A-6	0	100	100	95-100	80-90	30-40	10-16
8-32	SIL, L	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	24-40	3-15
32-60	SR-SL-SICL	ML, CL, CL-ML	A-4, A-6	0	100	90-100	70-80	55-70	24-40	3-15

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEA-BILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-8	18-27	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.3	-	LOW	.37	5	5	1-2	MODERATE	LOW
0-8	27-32	1.35-1.55	0.6-2.0	0.21-0.23	6.1-7.3	-	LOW	.37	5	6	1-2		
8-32	18-27	1.30-1.50	0.6-2.0	0.17-0.22	6.1-7.8	-	LOW	.37					
32-60	10-27	1.30-1.50	0.6-2.0	0.19-0.21	6.6-8.4	-	LOW	.37					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
RARE-COMMON	BRIEF	OCT-JUN	1.5-3.0	APPARENT	JAN-APR	-		>60		-		B	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	RARE: SEVERE-WETNESS COMMON: SEVERE-FLOODING,WETNESS
SEWAGE LAGOON AREAS	RARE: SEVERE-WETNESS COMMON: SEVERE-FLOODING,WETNESS
SANITARY LANDFILL (TRENCH)	RARE: SEVERE-WETNESS COMMON: SEVERE-FLOODING,WETNESS
SANITARY LANDFILL (AREA)	RARE: SEVERE-WETNESS COMMON: SEVERE-FLOODING,WETNESS
DAILY COVER FOR LANDFILL	FAIR-TOO CLAYEY,WETNESS

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-FLOODING
DWELLINGS WITH BASEMENTS	SEVERE-FLOODING,WETNESS
SMALL COMMERCIAL BUILDINGS	SEVERE-FLOODING
LOCAL ROADS AND STREETS	RARE: SEVERE-FROST ACTION COMMON: SEVERE-FLOODING,FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	RARE: MODERATE-WETNESS OCCAS: MODERATE-WETNESS,FLOODING FREQ: SEVERE-FLOODING

CONSTRUCTION MATERIAL

ROADFILL	FAIR-WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	SIL,L: GOOD SICL: FAIR-TOO CLAYEY

WATER MANAGEMENT

POND RESERVOIR AREA	MODERATE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING,WETNESS
EXCAVATED PONDS AQUIFER FED	MODERATE-SLOW REFILL
DRAINAGE	RARE: FROST ACTION COMMON: FLOODING,FROST ACTION
IRRIGATION	RARE: WETNESS,ERODES EASILY COMMON: WETNESS,ERODES EASILY,FLOODING
TERRACES AND DIVERSIONS	ERODES EASILY,WETNESS
GRASSED WATERWAYS	ERODES EASILY

THE HASKINS SERIES CONSISTS OF DEEP, SOMEWHAT POORLY DRAINED SOILS FORMED IN LOAMY WATER SORTED MATERIAL AND THE UNDERLYING GLACIAL TILL OR LACUSTRINE MATERIALS ON BEACH RIDGES, TERRACES, OUTWASH PLAINS AND TILL PLAINS. THE SURFACE LAYER IS DARK GRAYISH BROWN LOAM 8 INCHES THICK. THE SUBSURFACE LAYER IS LIGHT BROWNISH GRAY LOAM 2 INCHES THICK. THE SUBSOIL IS BROWN AND GRAYISH BROWN MOTTLED SANDY CLAY LOAM AND CLAY LOAM IN UPPER 20 INCHES. THE LOWER SUBSOIL AND SUBSTRATUM IS GRAYISH BROWN, MOTTLED CLAY. SLOPES RANGE FROM 0 TO 6 PERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-10	L, SIL	CL-ML, CL	A-4, A-6	0	95-100	85-100	70-100	55-90	25-40	5-20
0-10	FSL, SL	SM, ML	A-4, A-2	0	95-100	85-100	55-85	25-55	<30	NP-5
10-30	SCL, CL, GR-SCL	SC, CL	A-6, A-4, A-2	0	85-100	70-100	55-85	30-65	20-40	7-20
30-60	C, SIC, CL	CH, CL	A-7, A-6	0	100	85-100	80-100	70-95	35-65	15-40

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-10	12-20	1.30-1.45	0.6-2.0	0.18-0.22	5.1-7.3	-	LOW	.37	4	5	1-4	HIGH	MODERATE
0-10	10-18	1.30-1.45	0.6-2.0	0.12-0.18	5.1-7.3	-	LOW	.24	4	3	1-4		
10-30	18-35	1.45-1.70	0.6-2.0	0.12-0.16	5.1-7.3	-	LOW	.37					
30-60	35-55	1.60-1.80	<0.2	0.08-0.12	6.1-8.4	-	MODERATE	.37					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			1.0-2.5	PERCHED	JAN-APR	-		>60		-		C	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS,PERCS SLOWLY
SEWAGE LAGOON AREAS	0-2%: MODERATE-SEEPAGE 2-6%: MODERATE-SLOPE,SEEPAGE
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS,TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-WETNESS
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY,HARD TO PACK,WETNESS

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS
LOCAL ROADS AND STREETS	SEVERE-FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	MODERATE-WETNESS

CONSTRUCTION MATERIAL

ROADFILL	POOR-LOW STRENGTH
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	FAIR-SMALL STONES,THIN LAYER

WATER MANAGEMENT

POND RESERVOIR AREA	0-3%: MODERATE-SEEPAGE 3-6%: MODERATE-SEEPAGE,SLOPE
EMBANKMENTS DIKES AND LEVEES	MODERATE-HARD TO PACK,WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	0-3%: PERCS SLOWLY,FROST ACTION 3+%: PERCS SLOWLY,FROST ACTION,SLOPE
IRRIGATION	L,SIL: WETNESS,PERCS SLOWLY FSL,SL: WETNESS,SOIL BLOWING,PERCS SLOWLY
TERRACES AND DIVERSIONS	L,SIL: ERODES EASILY,WETNESS FSL,SL: ERODES EASILY,WETNESS,SOIL BLOWING
GRASSED WATERWAYS	WETNESS,ERODES EASILY,ROOTING DEPTH

THE HOUGHTON SERIES CONSISTS OF VERY POORLY DRAINED SOILS FORMED IN HERBACEOUS ORGANIC DEPOSITS IN BOGS AND OTHER DEPRESSIONAL AREAS WITHIN OUTWASH PLAINS, LAKE PLAINS, TILL PLAINS AND MORAINES. THE SURFACE LAYER IS BLACK MUCK 9 INCHES THICK. THE UNDERLYING LAYERS ARE BLACK AND DARK REDDISH BROWN SAPRIC MATERIAL. SLOPES ARE LESS THAN 2 PERCENT. MOST OF THESE SOILS ARE DRAINED AND USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-66	SP	PT	A-8	0						

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-66		0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-		-	2	2	>70	HIGH	LOW

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			+1-1.0	APPARENT	SEP-JUN	-		>60		1-4	55-60	A/D	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PONDING, PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-SEEPAGE, PONDING, EXCESS HUMUS
SANITARY LANDFILL (TRENCH)	SEVERE-PONDING, EXCESS HUMUS
SANITARY LANDFILL (AREA)	SEVERE-PONDING, SEEPAGE
DAILY COVER FOR LANDFILL	POOR-PONDING, EXCESS HUMUS

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-PONDING, EXCESS HUMUS
DWELLINGS WITHOUT BASEMENTS	SEVERE-PONDING, LOW STRENGTH
DWELLINGS WITH BASEMENTS	SEVERE-PONDING, LOW STRENGTH
SMALL COMMERCIAL BUILDINGS	SEVERE-PONDING, LOW STRENGTH
LOCAL ROADS AND STREETS	SEVERE-PONDING, LOW STRENGTH, FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-EXCESS HUMUS, PONDING

CONSTRUCTION MATERIAL

ROADFILL	POOR-WETNESS, LOW STRENGTH
SAND	IMPROBABLE-EXCESS HUMUS
GRAVEL	IMPROBABLE-EXCESS HUMUS
TOPSOIL	POOR-WETNESS, EXCESS HUMUS

WATER MANAGEMENT

POND RESERVOIR AREA	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-EXCESS HUMUS, PONDING
EXCAVATED PONDS AQUIFER FED	SEVERE-SLOW REFILL
DRAINAGE	FROST ACTION, SUBSIDES, PONDING
IRRIGATION	SOIL BLOWING, PONDING
TERRACES AND DIVERSIONS	PONDING, SOIL BLOWING
GRASSED WATERWAYS	WETNESS

ONTGOMERY SERIES, GRAVELLY SUBSTRATUM, CONSISTS OF DEEP, VERY POORLY DRAINED SOILS FORMED IN LACUSTRINE SEDIMENTS SLACK WATER TERRACES. THE SURFACE LAYER IS VERY DARK GRAY SILTY CLAY LOAM 12 INCHES THICK. THE SUBSOIL IS DARK GRAY TLED SILTY CLAY IN THE UPPER 23 INCHES AND BROWN, MOTTLED, GRAVELLY LOAM IN THE LOWER 12 INCHES. THE SUBSTRATUM IS YISH BROWN GRAVELLY SANDY LOAM AND GRAVELLY LOAM. SLOPES ARE 0 TO 2 PERCENT. CROPLAND AND PASTURELAND ARE THE NCIPAL LAND USES.

ESTIMATED SOIL PROPERTIES

PTH (N.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
-10	SICL	CL	A-7	0	100	100	100	85-98	40-50	20-28
-33	SIC	CH	A-7	0	100	100	95-100	90-98	55-65	34-42
-45	GR-CL, CL	CL, SC, GC	A-6	0-5	65-100	60-90	55-80	45-70	30-40	18-28
-60	GR-SL, GR-L	CL, GC, SC	A-2, A-4, A-6, A-7	0-10	55-85	50-80	40-75	25-55	30-45	8-20

PTH (N.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
-10	35-40	1.35-1.55	0.2-0.6	0.21-0.23	6.1-7.3	-	HIGH	.28	4	7	5-8	HIGH	LOW
-33	40-55	1.45-1.65	0.06-0.2	0.11-0.13	6.6-7.8	-	HIGH	.28					
-45	30-40	1.50-1.70	0.2-2.0	0.09-0.15	7.4-7.8	-	MODERATE	.28					
-60	13-25	1.50-1.70	2.0-20	0.05-0.10	7.4-8.4	-	LOW	.28					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			+1-1.0	APPARENT	DEC-MAY	-		>60		-		D	HIGH

SANITARY FACILITIES

PTIC TANK BSORPTION FIELDS	SEVERE-PONDING,PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-SEEPAGE,PONDING
NITARY LANDFILL (TRENCH)	SEVERE-SEEPAGE,PONDING,TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-PONDING
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY,HARD TO PACK,PONDING

BUILDING SITE DEVELOPMENT

SHALLOW CAVATIONS	SEVERE-PONDING
WELLINGS WITHOUT BASEMENTS	SEVERE-PONDING,SHRINK-SWELL
WELLINGS WITH BASEMENTS	SEVERE-PONDING,SHRINK-SWELL
SMALL COMMERCIAL UILDINGS	SEVERE-PONDING,SHRINK-SWELL
LOCAL OADS AND TREETS	SEVERE-LOW STRENGTH,PONDING,FROST ACTION
LAWNS, NDSCAPING AND GOLF FAIRWAYS	SEVERE-PONDING

CONSTRUCTION MATERIAL

ROADFILL	POOR-WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-AREA RECLAIM,WETNESS

WATER MANAGEMENT

POND RESERVOIR AREA	MODERATE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-HARD TO PACK,PONDING
EXCAVATED PONDS AQUIFER FED	SEVERE-SLOW REFILL
DRAINAGE	PONDING,PERCS SLOWLY,FROST ACTION
IRRIGATION	PONDING,PERCS SLOWLY
TERRACES AND DIVERSIONS	PONDING,PERCS SLOWLY
GRASSED WATERWAYS	WETNESS,PERCS SLOWLY

HE MORLEY SERIES, WELL DRAINED, CONSISTS OF WELL DRAINED SOILS FORMED IN GLACIAL TILL ON UPLANDS. THE SURFACE LAYER IS ERY DARK GRAY SILT LOAM 4 INCHES THICK. THE SUBSURFACE LAYER IS GRAYISH BROWN SILT LOAM 5 INCHES THICK. THE SUBSOIL IS ROWN SILTY CLAY LOAM AND SILTY CLAY 33 INCHES THICK. THE SUBSTRATUM IS BROWN SILTY CLAY LOAM. SLOPES RANGE FROM 1 TO 50 ERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-9	SIL, L	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	75-95	25-40	5-15
9-14	SICL, CL	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
14-28	SIC, CL, C	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
28-42	SICL, CL, SIC	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
42-60	SICL, CL	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-9	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	-	LOW	.43	3	6	1-3	HIGH	MODERATE
9-14	27-40	1.45-1.65	0.2-0.6	0.18-0.20	5.1-6.5	-	MODERATE	.43					
14-28	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	-	MODERATE	.43					
28-42	27-50	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	-	MODERATE	.43					
42-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	-	MODERATE	.43					

FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		C	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	1-15%: SEVERE-PERCS SLOWLY 15+%: SEVERE-PERCS SLOWLY,SLOPE
SEWAGE LAGOON AREAS	1-2%: SLIGHT 2-7%: MODERATE-SLOPE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	1-6%: MODERATE-TOO CLAYEY 6-15%: MODERATE-SLOPE,TOO CLAYEY 15+%: SEVERE-SLOPE
SANITARY LANDFILL (AREA)	1-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DAILY COVER FOR LANDFILL	1-8%: FAIR-TOO CLAYEY 8-15%: FAIR-TOO CLAYEY,SLOPE 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	1-8%: MODERATE-TOO CLAYEY 8-15%: MODERATE-TOO CLAYEY,SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	1-8%: MODERATE-SHRINK-SWELL 8-15%: MODERATE-SHRINK-SWELL,SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	1-8%: MODERATE-SHRINK-SWELL 8-15%: MODERATE-SLOPE,SHRINK-SWELL 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	1-4%: MODERATE-SHRINK-SWELL 4-8%: MODERATE-SHRINK-SWELL,SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	1-15%: SEVERE-LOW STRENGTH 15+%: SEVERE-LOW STRENGTH,SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	1-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	1-25%: POOR-LOW STRENGTH 25+%: POOR-LOW STRENGTH,SLOPE
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	1-15%: POOR-THIN LAYER 15+%: POOR-THIN LAYER,SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	1-3%: SLIGHT 3-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SLIGHT
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	1-3%: PERCS SLOWLY 3+%: PERCS SLOWLY,SLOPE
TERRACES AND DIVERSIONS	1-8%: ERODES EASILY,PERCS SLOWLY 8+%: SLOPE,ERODES EASILY,PERCS SLOWLY
GRASSED WATERWAYS	1-8%: ERODES EASILY,PERCS SLOWLY 8+%: SLOPE,ERODES EASILY,PERCS SLOWLT

THE PARR SERIES CONSISTS OF DEEP, WELL DRAINED SOILS FORMED IN GLACIAL TILL ON UPLANDS. THE SURFACE SOIL IS VERY DARK BROWN SILT LOAM 11 INCHES THICK. THE SUBSOIL IS DARK YELLOWISH BROWN CLAY LOAM 20 INCHES THICK. THE SUBSTRATUM IS VERY PALE BROWN AND YELLOWISH BROWN LOAM. SLOPES RANGE FROM 0 TO 18 PERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-11	SIL, L	CL, CL-ML	A-4	0	100	95-100	80-100	50-90	20-30	4-10
0-11	FSL	SM, SM-SC	A-4	0	100	100	65-80	35-45	<25	2-7
0-11	CL	CL	A-6	0	100	95-100	85-100	65-80	30-35	10-15
11-31	CL, L	CL	A-6, A-4	0	90-100	90-95	80-90	65-75	25-35	8-15
31-60	L	CL, ML, CL-ML	A-4	0-3	85-95	80-90	75-85	50-65	<25	2-9

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND ERODIBILITY GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-11	12-22	1.30-1.45	0.6-2.0	0.21-0.24	5.6-7.3	-	LOW	.32	5	5	3-5	MODERATE	MODERATE
0-11	10-18	1.35-1.50	0.6-2.0	0.16-0.18	5.6-7.3	-	LOW	.20	5	3	3-5		
0-11	27-30	1.35-1.50	0.6-2.0	0.17-0.19	5.6-7.3	-	MODERATE	.32	4	6	2-4		
11-31	20-30	1.40-1.55	0.6-2.0	0.15-0.19	5.6-6.5	-	MODERATE	.32					
31-60	8-20	1.40-1.60	0.6-2.0	0.05-0.19	7.4-8.4	-	LOW	.32					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-8%: MODERATE-PERCS SLOWLY 8-15%: MODERATE-SLOPE,PERCS SLOWLY 15+%: SEVERE-SLOPE.
SEWAGE LAGOON AREAS	0-2%: MODERATE-SEEPAGE 2-7%: MODERATE-SEEPAGE,SLOPE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SANITARY LANDFILL (AREA)	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DAILY COVER FOR LANDFILL	0-8%: GOOD 8-15%: FAIR-SLOPE 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: MODERATE-SHRINK-SWELL 8-15%: MODERATE-SHRINK-SWELL,SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-SHRINK-SWELL 4-8%: MODERATE-SHRINK-SWELL,SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: MODERATE-LOW STRENGTH,FROST ACTION 8-15%: MODERATE-LOW STRENGTH,SLOPE, FROST ACTION 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: GOOD 15-18%: FAIR-SLOPE
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	0-8% SIL,L,FSL: FAIR-SMALL STONES 8-15% SIL,L,FSL: FAIR-SMALL STONES,SLOPE 0-8% CL: FAIR-TOO CLAYEY,SMALL STONES 8-15% CL: FAIR-TOO CLAYEY,SMALL STONES,SLOPE 15+%: POOR-SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	0-3%: MODERATE-SEEPAGE 3-8%: MODERATE-SEEPAGE,SLOPE 8+%: SEVERE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3% SIL,L,CL: FAVORABLE 3+% SIL,L,CL: SLOPE 0-3% FSL: SOIL BLOWING 3+% FSL: SOIL BLOWING,SLOPE
TERRACES AND DIVERSIONS	0-8% SIL,L,CL: FAVORABLE 8+% SIL,L,CL: SLOPE 0-8% FSL: SOIL BLOWING 8+% FSL: SLOPE,SOIL BLOWING
GRASSED WATERWAYS	0-8%: FAVORABLE 8+%: SLOPE

TYPIC ARGIAQUOLLS, FINE, MIXED, MESIC

THE PEWAMO SERIES CONSISTS OF POORLY DRAINED AND VERY POORLY DRAINED SOILS FORMED IN CLAYEY GLACIAL TILL OR LACUSTRINE SEDIMENTS ON TILL PLAINS, LAKE PLAINS AND MORAINES. THE SURFACE LAYER IS VERY DARK BROWN CLAY LOAM 13 INCHES THICK. THE SUBSOIL IS DARK GRAY AND GRAY MOTTLED SILTY CLAY 24 INCHES THICK. THE SUBSTRATUM IS GRAYISH BROWN MOTTLED SILTY CLAY LOAM. SLOPES ARE 0 TO 2 PERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-13	L, SIL	ML, CL, CL-ML	A-4	0-5	90-100	80-100	80-95	60-95	20-35	3-10
0-13	CL, SICL, MK-SICL	CL	A-6, A-7	0-5	90-100	80-100	80-100	70-90	35-50	15-25
0-13	SIC, C	CH	A-7	0-5	90-100	80-100	80-100	75-95	50-55	25-30
13-37	CL, C, SIC	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
37-60	CL, SICL	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-13	18-27	1.35-1.55	0.6-2.0	0.20-0.22	6.1-7.3	-	LOW	.28	5	5	3-5	HIGH	LOW
0-13	27-40	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.3	-	MODERATE	.28	5	6	3-10		
0-13	40-45	1.35-1.55	0.2-0.6	0.12-0.20	6.1-7.3	-	MODERATE	.28	5	4	3-5		
13-37	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	-	MODERATE	.28					
37-60	30-40	1.50-1.75	0.2-0.6	0.14-0.18	7.4-8.4	-	MODERATE	.28					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			+1-1.0	APPARENT	DEC-MAY	-		>60		-		C/D	HIGH

SANITARY FACILITIES		CONSTRUCTION MATERIAL	
SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY,PONDING	ROADFILL	POOR-LOW STRENGTH,WETNESS
SEWAGE LAGOON AREAS	SEVERE-PONDING	SAND	IMPROBABLE-EXCESS FINES
SANITARY LANDFILL (TRENCH)	SEVERE-PONDING,TOO CLAYEY	GRAVEL	IMPROBABLE-EXCESS FINES
SANITARY LANDFILL (AREA)	SEVERE-PONDING	TOPSOIL	L,SIL,CL,SICL,MK-SICL: POOR-WETNESS SIC,C: POOR-WETNESS,TOO CLAYEY
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY,PONDING,HARD TO PACK		

BUILDING SITE DEVELOPMENT		WATER MANAGEMENT	
		POND RESERVOIR AREA	SLIGHT
SHALLOW EXCAVATIONS	SEVERE-PONDING	EMBANKMENTS DIKES AND LEVEES	SEVERE-PONDING
DWELLINGS WITHOUT BASEMENTS	SEVERE-PONDING	EXCAVATED PONDS AQUIFER FED	SEVERE-SLOW REFILL
DWELLINGS WITH BASEMENTS	SEVERE-PONDING	DRAINAGE	PONDING,FROST ACTION
SMALL COMMERCIAL BUILDINGS	SEVERE-PONDING	IRRIGATION	L,SIL,CL,SICL,MK-SICL: PONDING SIC,C: SLOW INTAKE,PONDING
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH,PONDING,FROST ACTION	TERRACES AND DIVERSIONS	PONDING
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	L,SIL,CL,SICL,MK-SICL: SEVERE-PONDING SIC,C: SEVERE-TOO CLAYEY,PONDING	GRASSED WATERWAYS	WETNESS

THE PLAINFIELD CONSISTS OF DEEP, EXCESSIVELY DRAINED SOILS FORMED IN SANDY DRIFT ON OUTWASH PLAINS, STREAM TERRACES AND GLACIAL MORAINES. THE SURFACE LAYER IS BROWN LOAMY SAND 8 INCHES THICK. THE SUBSOIL IS DARK YELLOWISH-BROWN SAND 12 INCHES THICK. THE SUBSTRATUM IS YELLOWISH BROWN SAND AND LIGHT YELLOWISH BROWN FINE SAND. SLOPES RANGE FROM 0 TO 35 PERCENT. USED MOSTLY FOR PASTURE AND WOODLAND. SOME AREAS ARE IRRIGATED AND USED TO GROW VEGETABLE AND GENERAL FARM CROPS.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-8	LS, LFS	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	-	NP
0-8	S, FS	SP-SM, SM, SP	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	-	NP
8-48	S	SP	A-3, A-1, A-2	0	75-100	75-100	40-70	1-4	-	NP
48-60	S, FS	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	-	NP

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-8	3-15	1.35-1.65	2.0-6.0	0.09-0.12	4.5-7.3	-	LOW	.17	5	2	<1	LOW	HIGH
0-8	2-9	1.35-1.65	6.0-20	0.04-0.09	4.5-7.3	-	LOW	.15	5	1	<1		
8-48	1-4	1.50-1.65	6.0-20	0.04-0.07	4.5-6.5	-	LOW	.17					
48-60	1-4	1.50-1.75	6.0-20	0.04-0.07	4.5-6.5	-	LOW	.17					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		A	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-15%: SEVERE-POOR FILTER 15+%: SEVERE-SLOPE, POOR FILTER
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE, SLOPE
SANITARY LANDFILL (TRENCH)	0-15%: SEVERE-SEEPAGE, TOO SANDY 15+%: SEVERE-SEEPAGE, SLOPE, TOO SANDY
SANITARY LANDFILL (AREA)	0-15%: SEVERE-SEEPAGE 15+%: SEVERE-SEEPAGE, SLOPE
DAILY COVER FOR LANDFILL	0-15%: POOR-TOO SANDY, SEEPAGE 15+%: POOR-TOO SANDY, SLOPE, SEEPAGE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-15%: SEVERE-CUTBANKS CAVE 15+%: SEVERE-CUTBANKS CAVE, SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8% LFS, LS: MODERATE-DROUGHTY 8-15% LFS, LS: MODERATE-SLOPE, DROUGHTY 15+% LFS, LS: SEVERE-SLOPE 0-15% S, FS: SEVERE-DROUGHTY 15+% S, FS: SEVERE-DROUGHTY, SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: GOOD 15-25%: FAIR-SLOPE 25+%: POOR-SLOPE
SAND	PROBABLE
GRAVEL	IMPROBABLE-TOO SANDY
TOPSOIL	0-15% LFS, LS: POOR-THIN LAYER 15+% LFS, LS: POOR-SLOPE, THIN LAYER 0-15% S, FS: POOR-TOO SANDY 15+% S, FS: POOR-TOO SANDY, SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	0-8%: SEVERE-SEEPAGE 8+%: SEVERE-SEEPAGE, SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-SEEPAGE, PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	DROUGHTY, FAST INTAKE, SOIL BLOWING
TERRACES AND DIVERSIONS	0-8%: TOO SANDY, SOIL BLOWING 8+%: SLOPE, TOO SANDY, SOIL BLOWING
GRASSED WATERWAYS	0-8%: DROUGHTY 8+%: DROUGHTY, SLOPE

THE RAWSON VARIANT CONSISTS OF DEEP, WELL DRAINED SOILS FORMED IN LOAMY SEDIMENTS AND THE UNDERLYING GLACIAL TILL ON TILL PLAINS AND MORAINES. THE SURFACE LAYER IS DARK GRAYISH BROWN SANDY LOAM 9 INCHES THICK. THE SUBSOIL IS BROWN SANDY LOAM, SANDY CLAY LOAM AND GRAVELLY SANDY CLAY LOAM IN THE UPPER 27 INCHES AND YELLOWISH BROWN CLAY LOAM IN THE LOWER 6 INCHES. THE SUBSTRATUM IS GRAYISH BROWN CLAY LOAM. SLOPES RANGE FROM 2 TO 25 PERCENT. CROPLAND IS THE DOMINANT USE.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLAS-TICITY INDEX
0-9	SL	SM, SM-SC, ML, CL-ML	A-4, A-2	0	95-100	90-100	60-85	30-68	<28	NP-7
9-36	SL, SCL	SM-SC, ML, CL, CL-ML	A-4, A-6	0	85-100	85-100	55-88	38-65	<30	NP-11
36-60	CL, SICL	CL	A-6	0-5	95-100	95-100	85-100	66-95	30-40	11-16

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEA-BILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-9	5-18	1.30-1.45	0.6-2.0	0.13-0.18	6.1-7.3	-	LOW	.24	4	3	1-3	MODERATE	LOW
9-36	5-27	1.35-1.60	0.6-2.0	0.13-0.19	5.6-7.3	-	LOW	.32					
36-60	28-35	1.40-1.65	0.06-0.2	0.14-0.20	6.6-8.4	-	MODERATE	.32					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			3.0-6.0	PERCHED	JAN-APR	-		>60		-		B	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	2-15%: SEVERE-WETNESS, PERCS SLOWLY 15+%: SEVERE-WETNESS, PERCS SLOWLY, SLOPE
SEWAGE LAGOON AREAS	2-7%: SEVERE-WETNESS 7+%: SEVERE-SLOPE, WETNESS
SANITARY LANDFILL (TRENCH)	2-8%: MODERATE-WETNESS 8-15%: MODERATE-WETNESS, SLOPE 15+%: SEVERE-SLOPE
SANITARY LANDFILL (AREA)	2-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DAILY COVER FOR LANDFILL	2-8%: FAIR-WETNESS 8-15%: FAIR-SLOPE, WETNESS 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	2-8%: MODERATE-WETNESS 8-15%: MODERATE-WETNESS, SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	2-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	2-8%: MODERATE-WETNESS 8-15%: MODERATE-WETNESS, SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	2-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	2-8%: MODERATE-FROST ACTION 8-15%: MODERATE-SLOPE, FROST ACTION 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	2-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	2-15%: FAIR-THIN LAYER 15-25%: FAIR-THIN LAYER, SLOPE
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	2-8%: FAIR-SMALL STONES 8-15%: FAIR-SMALL STONES, SLOPE 15+%: POOR-SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	2-3%: MODERATE-SEEPAGE 3-8%: MODERATE-SEEPAGE, SLOPE 8+%: SEVERE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	2-3%: SOIL BLOWING, PERCS SLOWLY 3+%: SOIL BLOWING, PERCS SLOWLY, SLOPE
TERRACES AND DIVERSIONS	2-8%: SOIL BLOWING 8+%: SLOPE, SOIL BLOWING
GRASSED WATERWAYS	2-8%: PERCS SLOWLY 8+%: SLOPE, PERCS SLOWLY

TYPIC ARGIAQUOLLS, FINE-LOAMY OVER SANDY OR SANDY-SKELETAL, MIXED, MESIC

THE SEBEWA SERIES CONSISTS OF POORLY AND VERY POORLY DRAINED SOILS FORMED IN LOAMY AND SANDY GLACIOFLUVIAL DEPOSITS ON OUTWASH PLAINS, VALLEY TRAINS AND TERRACES. THE SURFACE SOIL IS VERY DARK GRAY AND DARK GRAY LOAM 14 INCHES THICK. THE SUBSOIL IS GRAY MOTTLED SANDY CLAY LOAM, CLAY LOAM AND GRAVELLY CLAY LOAM 22 INCHES THICK. THE SUBSTRATUM IS GRAY GRAVELLY SAND. SLOPES ARE 0 TO 3 PERCENT. MOST AREAS ARE USED FOR CROPLAND.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-14	L, SIL, MK-L	CL, CL-ML, ML	A-4, A-6	0	95-100	80-100	75-95	50-90	15-30	3-15
0-14	SL, SCL	SM, SM-SC, SC	A-2-4, A-4	0	95-100	80-100	55-70	25-40	<30	NP-10
0-14	CL, SICL	CL	A-6, A-4	0	95-100	80-100	75-95	70-90	25-35	9-16
14-36	SCL, L, GR-CL	SC, CL	A-4, A-6	0	95-100	65-95	55-85	40-75	25-40	8-20
36-60	GR-S	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	-	NP

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-14	10-25	1.10-1.60	0.6-2.0	0.18-0.25	6.1-7.8	-	LOW	.24	4	5	1-6	HIGH	LOW
0-14	5-25	1.15-1.60	0.6-2.0	0.12-0.20	6.1-7.8	-	LOW	.24	4	3	1-8		
0-14	27-32	1.15-1.60	0.6-2.0	0.17-0.19	6.1-7.8	-	LOW	.24	4	6	1-8		
14-36	18-35	1.50-1.80	0.6-2.0	0.15-0.19	6.1-7.8	-	LOW	.24					
36-60	0-3	1.55-1.75	6.0-20	0.02-0.04	7.4-8.4	-	LOW	.10					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			+1-1.0	APPARENT	SEP-MAY	-		>60		-		B/D	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-POOR FILTER,PONDING
SEWAGE LAGOON AREAS	SEVERE-SEEPAGE,PONDING
SANITARY LANDFILL (TRENCH)	SEVERE-SEEPAGE,PONDING,TOO SANDY
SANITARY LANDFILL (AREA)	SEVERE-SEEPAGE,PONDING
DAILY COVER FOR LANDFILL	POOR-SMALL STONES,SEEPAGE,TOO SANDY

CONSTRUCTION MATERIAL

ROADFILL	POOR-WETNESS
SAND	PROBABLE
GRAVEL	PROBABLE
TOPSOIL	POOR-WETNESS,SMALL STONES,AREA RECLAIM

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-CUTBANKS CAVE,PONDING
DWELLINGS WITHOUT BASEMENTS	SEVERE-PONDING
DWELLINGS WITH BASEMENTS	SEVERE-PONDING
SMALL COMMERCIAL BUILDINGS	SEVERE-PONDING
LOCAL ROADS AND STREETS	SEVERE-FROST ACTION,PONDING
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-PONDING

WATER MANAGEMENT

POND RESERVOIR AREA	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-SEEPAGE,PONDING
EXCAVATED PONDS AQUIFER FED	SEVERE-CUTBANKS CAVE
DRAINAGE	FROST ACTION,CUTBANKS CAVE,PONDING
IRRIGATION	L,SIL,MK-L,CL,SICL: PONDING SL,SCL: SOIL BLOWING,PONDING
TERRACES AND DIVERSIONS	L,SIL,MK-L,CL,SICL: TOO SANDY,PONDING SL,SCL: TOO SANDY,SOIL BLOWING,PONDING
GRASSED WATERWAYS	WETNESS

THAPTO-HISTIC FLUVAQUENTS, FINE-LOAMY, MIXED, NONACID, MESIC

THE WALLKILL SERIES, CLAYEY SUBSTRATUM, CONSISTS OF DEEP, VERY POORLY DRAINED SOILS FORMED IN OLD ALLUVIUM OVERLYING ORGANIC MATERIAL THAT ARE UNDERLAIN WITH LACUSTRINE SEDIMENTS. TYPICALLY THE SURFACE LAYER IS DARK GRAYISH-BROWN SILT LOAM 11 INCHES THICK. THE SUBSURFACE LAYER IS DARK GRAYISH-BROWN, MOTTLED SILT LOAM 7 INCHES THICK. THE NEXT LAYER IS BLACK AND VERY DARK GRAY MUCK 24 INCHES THICK. THE UNDERLYING MATERIAL IS BLACK SILTY CLAY. SLOPES RANGE FROM 0 TO 2 PERCENT. CULTIVATED CROPS IS THE DOMINANT USE.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-18	SIL	CL	A-4, A-6	0	100	95-100	90-100	80-95	24-34	8-15
18-42	SP	PT	A-8	0	-	-	-	-	-	-
42-60	SIC	CL, CH	A-7	0	100	95-100	90-100	85-95	40-55	20-30

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-18	12-25	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.8	-	LOW	.37	5	6	1-3	HIGH	MODERATE
18-42	-	0.35-0.55	2.0-6.0	0.35-0.45	5.1-7.3	-		.24					
42-60	40-50	1.45-1.60	0.06-0.2	0.10-0.12	6.1-7.8	-	HIGH	.32					

FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HIGH WATER TABLE DEPTH (FT)	HIGH WATER TABLE KIND	HIGH WATER TABLE MONTHS	CEMENTED PAN DEPTH (IN)	CEMENTED PAN HARDNESS	BEDROCK DEPTH (IN)	BEDROCK HARDNESS	SUBSIDENCE INIT. (IN)	SUBSIDENCE TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			+.5-1.0	APPARENT	DEC-MAY	-		>60			-	C/D	HIGH

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PONDING,PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-PONDING,SEEPAGE,EXCESS HUMUS
SANITARY LANDFILL (TRENCH)	SEVERE-PONDING,SEEPAGE,EXCESS HUMUS
SANITARY LANDFILL (AREA)	SEVERE-PONDING,SEEPAGE
DAILY COVER FOR LANDFILL	POOR-PONDING,EXCESS HUMUS,AREA RECLAIM

CONSTRUCTION MATERIAL

ROADFILL	POOR-AREA RECLAIM,WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-AREA RECLAIM,WETNESS

WATER MANAGEMENT

POND RESERVOIR AREA	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEVERE-EXCESS HUMUS,PONDING
EXCAVATED PONDS AQUIFER FED	SEVERE-SLOW REFILL
DRAINAGE	PONDING,FROST ACTION
IRRIGATION	PONDING,ERODES EASILY,PERCS SLOWLY
TERRACES AND DIVERSIONS	PONDING,ERODES EASILY,PERCS SLOWLY
GRASSED WATERWAYS	WETNESS,ERODES EASILY

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-PONDING,EXCESS HUMUS
DWELLINGS WITHOUT BASEMENTS	SEVERE-PONDING,LOW STRENGTH
DWELLINGS WITH BASEMENTS	SEVERE-PONDING
SMALL COMMERCIAL BUILDINGS	SEVERE-PONDING,LOW STRENGTH
LOCAL ROADS AND STREETS	SEVERE-PONDING,LOW STRENGTH,FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-PONDING,THIN LAYER

TYPIC ARGIUDOLLS, FINE-LOAMY OVER SANDY OR SANDY-SKELETAL, MIXED, MESIC

THE WARSAW SERIES CONSISTS OF WELL DRAINED SOILS FORMED IN OUTWASH SEDIMENTS ON OUTWASH PLAINS, TERRACES AND VALLEY TRAINS. THE SURFACE LAYER IS VERY DARK BROWN LOAM 14 INCHES THICK. THE SUBSOIL IS DARK BROWN AND BROWN LOAM AND SANDY CLAY LOAM IN UPPER 19 INCHES AND VERY DARK BROWN GRAVELLY SANDY CLAY LOAM IN LOWER 2 INCHES. THE SUBSTRATUM IS BROWN STRATIFIED SAND, GRAVELLY SAND AND VERY GRAVELLY SAND. SLOPES RANGE FROM 0 TO 15 PERCENT. CROPLAND IS THE MAIN USE.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-17	SIL, L	CL, CL-ML	A-4, A-6	0	80-100	75-100	70-100	50-90	20-30	4-12
0-17	SL	SC, SM-SC	A-2-4, A-4	0	80-100	75-100	50-70	25-40	<25	4-10
17-33	SCL, L, GR-CL	SC, CL, CL-ML, SM-SC	A-6,A-2-6,A-4,A-2-4	0-3	90-95	70-95	60-90	30-70	20-35	6-15
33-35	GR-SCL, GR-L	CL, SC, GC, SM-SC	A-6,A-2-6,A-4,A-2-4	0-5	70-90	60-85	55-70	30-60	20-35	6-15
35-60	SR-S-GRV-S	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	<20	NP

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-17	15-25	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	-	LOW	.28	4-3	5	2-5	LOW	MODERATE
0-17	12-20	1.35-1.60	0.6-2.0	0.13-0.15	5.6-7.3	-	LOW	.20	4	3	2-5		
17-33	17-30	1.35-1.60	0.6-2.0	0.16-0.19	5.1-6.5	-	LOW	.28					
33-35	17-30	1.40-1.65	0.6-2.0	0.15-0.17	6.6-8.4	-	LOW	.28					
35-60	2-8	1.40-1.65	>20	0.02-0.04	7.9-8.4	-	LOW	.10					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-POOR FILTER
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE,SLOPE
SANITARY LANDFILL (TRENCH)	SEVERE-SEEPAGE,TOO SANDY
SANITARY LANDFILL (AREA)	SEVERE-SEEPAGE
DAILY COVER FOR LANDFILL	POOR-SEEPAGE,TOO SANDY,SMALL STONES

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-CUTBANKS CAVE
DWELLINGS WITHOUT BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: MODERATE-FROST ACTION 8-15%: MODERATE-SLOPE,FROST ACTION
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	GOOD
SAND	PROBABLE
GRAVEL	PROBABLE
TOPSOIL	POOR-SMALL STONES,AREA RECLAIM

WATER MANAGEMENT

POND RESERVOIR AREA	0-8%: SEVERE-SEEPAGE 8+%: SEVERE-SEEPAGE,SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-SEEPAGE
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3% SIL,L: FAVORABLE 3+% SIL,L: SLOPE 0-3% SL: SOIL BLOWING 3+% SL: SOIL BLOWING,SLOPE
TERRACES AND DIVERSIONS	0-8% SIL,L: TOO SANDY 8+% SIL,L: SLOPE,TOO SANDY 0-8% SL: TOO SANDY,SOIL BLOWING 8+% SL: SLOPE,TOO SANDY,SOIL BLOWING
GRASSED WATERWAYS	0-8%: FAVORABLE 8+%: SLOPE

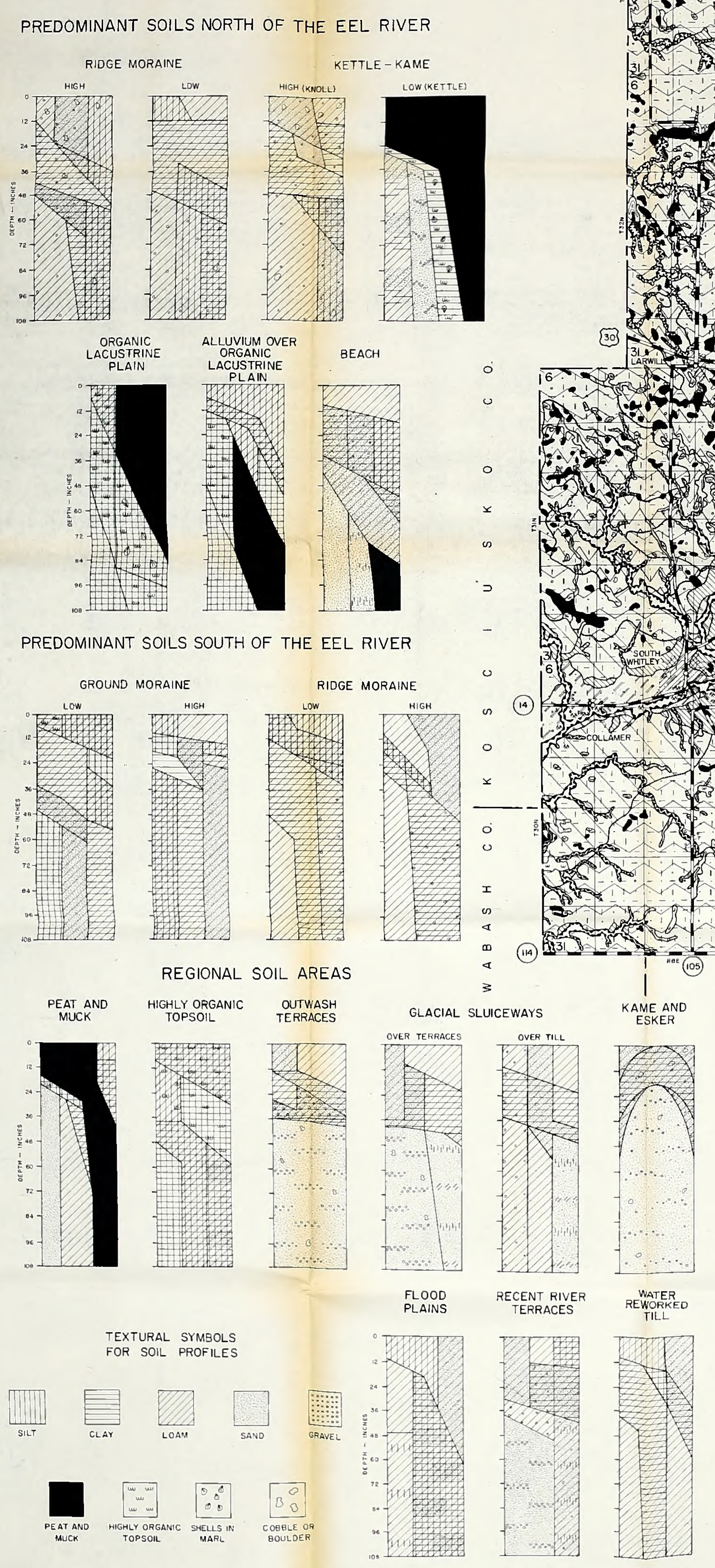
Appendix B - Borehole Data

Map borehole#	Job borehole#	Sample Station	Offset	Depth(ft.)	Classification: Textural	Classification: AASHTO	Percent: Gravel	Percent: Sand	Percent: Silt	Percent: Clay	LL	PL	PI
ST - Project No. 219-2(B) U.S. 33 in Whitley County													
1	RB-1	49+51	9'Rt.	1.0-2.5	Clay	A-6(11)	--	25.6	42.8	31.6	35.2	18.4	16.8
1	RB-1	49+51	9'Rt.	6.0-7.5	Gravelly Sand	A-1-b(0)	33.5	46.7	--19.8--		NP	NP	NP
2	RB-3	208+90	35'Rt.	3.5-5.0	Silty Clay	A-7-6(19)	--	5.7	64.2	30.1	41.0	22.7	18.3
RS - Project No. 3292(1) S.R. 14 over Mishler Ditch													
3	TB-1	193+85	14'Rt.	8.5-10.0	Sandy Gravel	A-1-b(0)	49.3	37.4	--13.3--		NP	NP	NP
3	TB-1	193+85	14'Rt.	28.5-30.0	Loam	A-4(0)	8.8	34.4	45.8	11.0	19.2	13.6	5.6
4	TB-3	194+44	28'Rt.	6.0-10.0	Sandy loam	A-4(0)	12.8	47.6	31.6	8.0	NP	NP	NP
5	TB-4	194+64	15'Lt.	6.0-7.5	Sandy loam w/organic	A-4(0)	15.9	45.5	32.2	6.4	NP	NP	NP
Project ST - 3392(1) PE S.R. 105 over Hurricane Creek													
6	TB-2	99+81	17'Rt.	23.5-25.0	Sandy loam	A-4(0)	2	60	24	14	NP	NP	NP
7	TB-4	100+34	18'Rt.	1.0-2.5	Gravelly Sand	A-1-b(0)	36	59	--5.0--		NP	NP	NP
7	TB-4	100+34	18'Rt.	6.0-7.5	Clay	A-6(5)	--	36	32	32	29	17	12
7	TB-4	100+34	18'Rt.	23.5-25.0	Sand	A-1-b(0)	16	82	--2.0--		NP	NP	NP
8	TB-3	100+19	12'Lt.	6.0-7.5	Clay loam	A-4(3)	2	27	47	24	25	17	8
8	TB-3	100+19	12'Lt.	8.5-10.0	Clay loam	A-4(2)	3	22	46	29	22	16	6
8	TB-3	100+19	12'Lt.	13.5-15.0	Gravelly Sand	A-1-b(0)	24	67	--9.0--		NP	NP	NP
8	TB-3	100+19	12'Lt.	18.5-20.0	Silty Clay loam	A-4(4)	2	18	53	27	24	16	8
9	TB-1	99+65	11'Lt.		See accompanying soil moisture data.								
ST - Project No. 099 - 5(E) S.R. 9 over Stoney Creek													
10	B-2	739+60.5	16'Lt.	9.0-10.5	Clay loam	A-4(0)	4.0	28.0	46	22	18	15	3
10	B-2	739+60.5	16'Lt.	19.0-20.0	Silty Clay	A-4(10)	--	0.7	61.8	37.5	32.4	22.4	10.0
10	B-2	739+60.5	16'Lt.	24.0-25.0	Clay loam	A-4(0)	8.7	32.8	37.0	21.5	17.1	12.3	4.8
10	B-2	739+60.5	16'Lt.	44.0-45.5	Sandy loam	A-4(0)	8.0	50.3	29.2	12.5	NP	NP	NP
11	B-1	739+11.5	15'Lt.	17.0-19.0	Silty Clay loam	A-4(5)	5	18.4	54.1	22.5	25.5	16.8	8.7
11	B-1	739+11.5	15'Lt.	29.0-30.5	Loam	A-4(1)	8	32.7	45.3	14.0	14.3	8.1	6.2
11	B-1	739+11.5	15'Lt.	44.0-45.5	Sandy loam	A-4(0)	10	49.5	27.5	13.0	NP	NP	NP
12	B-3	739+60	24'Rt.	14.0-15.5	Clay loam	A-4(0)	6.7	28.5	44.8	20.0	17.3	13.2	4.1
12	B-3	739+60	24'Rt.	24.0-25.5	Silty Clay loam	A-4(3)	--	0.8	79.2	20.0	24.3	20.0	4.3
12	B-3	739+60	24'Rt.	29.0-30.5	Sandy loam	A-4(0)	7.6	43.0	34.9	14.5	15.1	11.9	3.2
12	B-3	739+60	24'Rt.	39.0-40.5	Sandy loam	A-4(0)	13.3	51.0	25.7	10.0	NP	NP	NP

Appendix B - (Continued)

Map borehole#	Map borehole#	Sample Station	Offset	Depth(ft.)	Classification Textural	Classification AASHTO	Percent Gravel	Percent Sand	Percent Silt	Percent Clay	LL	PL	PI
					F - Project No. 099 - 5(2) S.R. 9 over Mud Run Creek								
13	TB-3	833+50	28'Lt.	2.5-4.0	Loam	A-4(1)	14	21.7	45.3	19.0	19.1	13.5	5.6
14	TB-1	832+79	28'Lt.	10.0-11.5	Sand	A-3(0)	40.4	50.3	--9.3--		NP	NP	NP
15	TB-2	833+10	29'Lt.	20.0-21.5	Sandy Gravel	A-1-B(0)	85.8	11.1	--3.1--		NP	NP	NP
16	TB-4	833+80	31'Lt.	7.5-9.0	Sand	A-3(0)	38.9	55.5	--5.6--		NP	NP	NP
16	TB-4	833+80	31'Lt.	20.0-21.5	Sandy loam	A-2-4(0)	11.1	53.7	26.6	8.6	NP	NP	NP
16	TB-4	833+80	31'Lt.	28.5-30.0	Silty loam	A-4(3)	10.5	11.4	58.8	19.3	22.2	14.9	7.3
					ST - Project No. 099 - 5(5) S.R. 9 over Blue Babe Ditch								
17	B-1	134+63	16'Lt.	14.0-15.5	Gravelly Sand	A-1-b(0)	37	47	--16--		NP	NP	NP
17	B-1	134+63	16'Lt.	19.0-20.5	Sand	A-1-b(0)	18	71	--11--		NP	NP	NP
18	B-2	135+18	14'Lt.	25.5-27.0	Sandy loam	A-4(0)	12	44	34	10	NP	NP	NP
18	B-2	135+18	14'Lt.	35.5-37.0	Sandy loam	A-4(0)	46	31	15	15	12	3	
18	B-2	135+18	14'Lt.	40.5-42.0	Clay loam	A-4(0)	7	29	38	26	16	11	5
18	B-2	135+18	14'Lt.	46.5-47.0	Sandy loam	A-2-4(0)	19	53	23	5	NP	NP	NP
18	B-2	135+18	14'Lt.	50.5-51.5	Loam	A-4(0)	8	32	40	20	18	14	4
19	B-3	135+48	13'Rt.	4.0-5.5	Sandy Gravel	A-1-a(0)	70	23	-- 7--		NP	NP	NP
19	B-3	135+48	13'Rt.	29.0-30.5	Sand	A-3(0)	13	82	-- 5--		NP	NP	NP
19	B-3	135+48	13'Rt.	34.0-35.5	Sandy loam	A-4(0)	8	43	41	8	NP	NP	NP
					ST - Project No. 9999(2), Site No. 3 Landslide/Subsidence on U.S. 30								
20	B-1	268+00	78'Lt.	12.5-14.0	Gravelly Sand	A-1-b(0)	40	52	4	4	NP	NP	NP
20	B-1	268+00	78'Lt.	22.5-24.0	Gravelly Sand	A-2-4(0)	23	59	14	4	NP	NP	NP
20	B-1	268+00	78'Lt.	52.5-54.0	Sand	A-2-4(0)	15	67	11	7	NP	NP	NP
21	B-2	269+00	78'Lt.	61.5-63.5	Loam	A-4(0)	6	31	46	17	17.3	13.1	4.2
22	B-4	266+00	85'Lt.	12.5-14.5	Marl and Peat	A-8	--	78	8	14	NP	NP	NP
23	B-5	265+00	91'Lt.	7.5-9.0	Silty Clay loam	A-4(3)	--	15	58	27	22.2	14.9	7.3
23	B-5	265+00	91'Lt.	19.5-21.0	Clay loam	A-4(2)	3	31	34	32	19.4	11.3	8.1
24	B-10	268+00	91'Rt.	45.0-46.5	Sandy loam w/gravel	A-6(3)	33	17	32	18	29.7	16.2	13.5
25	B-6	269+20	55'Lt.	6.0-7.5	Loam	A-4(2)	4.3	31.6	46.3	17.8	21.4	13.5	7.9
26	B-7	270+30	55'Lt.	48.5-50.0	Loam	A-4(0)	4.9	28.3	49.1	17.7	17.5	12.5	5.0
27	B-11	268+02	133'Rt.	8.0-10.0	Peat w/marl	A-8(0)	2.9	76.0	18.1	3.0	NP	NP	NP

GENERAL SOIL PROFILES



ENGINEERING SOILS MAP

WHITLEY COUNTY

INDIANA

PREPARED FROM
1951 A A A AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1984

SCALE OF MILES

PREPARED UNDER THE SUPERVISION OF E. M. GEFELL AND R. D. MILES

ENGINEERING SOILS MAP

WHITLEY COUNTY

INDIANA

PREPARED FROM

1951 A A A AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1984

SCALE OF MILES

LEGEND

PARENT MATERIALS
(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- GROUND MORAINE
- RIDGE MORAINE
- KETTLE-KAME MORAINE
- OUTWASH TERRACE
- RECENT RIVER TERRACE
- BEACH
- FLOOD PLAIN
- GLACIAL SLUICEWAY
- WATER REWORKED TILL
- ORGANIC LACUSTRINE PLAIN
- KAME AND ESKER
- SLACKWATER LACUSTRINE PLAIN

MISCELLANEOUS

- LAKE OR POND
- SAND OR GRAVEL PIT
- BORING SITES
- URBAN AREAS

TEXTURAL SYMBOLS
(SUPERIMPOSED ON PARENT MATERIAL TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- COBBLE OR BOULDER
- PEAT AND MUCK
- SILT
- CLAY
- HIGHLY ORGANIC TOP SOIL

DRAWN BY D. W. GONZALES

COVER DESIGN BY ALDO GIORGINI